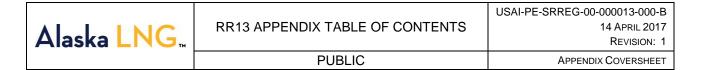
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ALASKA LNG

DOCKET NO. CP17-___-000
RESOURCE REPORT NO. 13
ENGINEERING AND DESIGN MATERIAL
(LIQUEFIED NATURAL GAS)
PUBLIC

DOCUMENT NUMBER: USAI-PE-SRREG-00-000013-000-B



APPENDIX 13A – PROJECT MANAGEMENT

A.1 – Site Location Maps and Drawing

Document Number:	Description:	Revision:	Appendix:
Figure 3_2_1-1 Liquefaction Facility Area Plan	Liquefaction Facility Area Plan	N/A	Public
USAL-CB-LDLAY-00-00003-000	LNG Liquefaction Facility – Overall Complex Site Plan	Rev 6	Public

A.2 – Organization Chart

Document Number:	Description:	Revision:	Appendix:
USAL-PL-BAORG-00-000001-000	Organizational Chart	0	Public

A.3 - Construction Workforce Organizational Chart*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

A.4 - Operation Workforce Organizational Chart*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

A.5 - Project Schedule

Document Number:	Description:	Revision:	Appendix:
USAI-PT-BYSCH-00-000001-000	Integrated Project Summary Schedule	Rev 0A	Public

APPENDIX 13B – DESIGN BASIS, CRITERIA, AND PHILOSOPHIES

B.1 - Process Safety Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-00-000001-000	Process Safety Design Basis	Rev 3	P&C



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B.2 - Flare Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-00-000008-000	Design Basis – Flare System	Rev 2	P&C

B.3 - Fractionation Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-50-000002-000	Design Basis – Fractionation	Rev 0	P&C

B.4 - Fresh Water System Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-60-000004-000	Design Basis – Fresh Water System	Rev 0	P&C

B.5 - Fuel Gas System Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-50-000003-000	Design Basis – Fuel Gas System	Rev 0	P&C

B.6 - Inlet Treating, Mercury Removal and Dehydration System Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-50-000001-000	Design Basis - Inlet Treating, Mercury Removal and Dehydration System	Rev 1	P&C

B.7 - Liquefaction and Refrigeration System Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-00-000006-000	Design Basis – Liquefaction and Refrigeration System	Rev 0	P&C

B.8 - LNG Storage and Loading Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-80-000001-000	Design Basis – LNG Storage and Loading	Rev 1	P&C

B.9 - Nitrogen System Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-60-000003-000	Design Basis - Nitrogen System	Rev 1	P&C



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B.10 - Plant and Instrument Air System Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-60-000002-000	Design Basis – Plant and Instrument Air System	Rev 0	P&C

B.11 - Refrigerant, Condensate and Diesel Storage Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-50-000001-000	Design Basis – Refrigerant, Condensate and Diesel Storage	Rev 3	P&C

B.12 - Rainfall Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-00-000005-000	Rainfall Design Basis	Rev 1	P&C

B.13 - Seismic Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-NBDES-00-000003-000	Seismic Design Basis	Rev 1	P&C

B.14 - Structural Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-NBDES-00-000004-000	Structural Design Criteria	Rev 0	P&C

B.15 - Wind Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-NBDES-00-000002-000	Wind Design Basis	Rev 1	P&C

B.16 - Civil Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-CBDES-00-000001-000	Civil Design Criteria	Rev 2	P&C

B.17 - Electrical Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-EBDES-00-000001-000	Electrical Design Basis	Rev 1	P&C



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B.18 - Integrated Control and System Safety Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-IBICS-00-000005-000	Integrated Control and System Safety Design Basis	Rev 1	P&C

B.19 - Waste Water Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-70-000001-000	Design Basis – Waste Water Treatment	Rev 1	P&C

B.20 - Steam and Power Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PBDES-60-000005-000	Design Basis – Steam and Power	Rev 1	P&C

B.21 - Firewater System Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FBDES-00-000002-000	Fire Protection System Design Basis	Rev 4	CEII

B.22 – Multidiscipline Design Basis

Document Number:	Description:	Revision:	Appendix:
USAL-PT-BBFDB-40-0001	Multidiscipline Design Basis	Rev 1	CEII

B.23 - Metaocean and Ice Basis of Design

Document Number:	Description:	Revision:	Appendix:
USAKL-PT-BBSIT-40-0001	Metocean and Ice Basis Of Design	Rev 4	CEII

APPENDIX 13C - REGULATIONS AND PERMITS

C.1 – Table of Regulatory Agencies, Permits, and Approvals

Document Number:	Description:	Revision:	Appendix:
USAL-CB-SPREG-00-000001-000	Permit Matrix	Rev 0	Public

C.2 – Regulatory Agency Correspondence

Document Number:	Description:	Revision:	Appendix:
N/A	Refer to Resource Report 1 and Resource Report 11	N/A	Public



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C.3 – Regulatory Compliance Matrix

Document Number:	Description:	Revision:	Appendix:
USAI-PE-SRREG-00-000011-000	Demonstration of Code Compliance	0	Public

C.4 - Tank Equivalency

Document Number:	Description:	Revision:	Appendix:
USAL-OT-PRTEC-80-000002-000	Report on Equivalency of NFPA 59A-2001, 2006 and 2013 Editions	1	P&C

C.5 – Pipe in Pipe Equivalency

Document Number:	Description:	Revision:	Appendix:
USAL-CB-SGWHT-00-000001-000	Pipe In Pipe Regulatory Equivalency	1	P&C

C.6 - Sump Sizing Spill Duration

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-ENV-RTA-DOC-00002	Sump Sizing Spill Duration Justification	0	P&C

APPENDIX 13D - CODES AND STANDARDS

D.1 - List of Codes and Standards

Document Number:	Description:	Revision:	Appendix:
USAL-CB-BSCOD-00-000001-000	Engineering Codes and Standards List	2	Public
AKLNG-4030-VVV-SPC-DOC-00001	EPC Contractor Codes and Standards List	0	Public

APPENDIX 13E - ENGINEERING DESIGN INFORMATION

E.1 – Block Diagram of Facilities

Document Number:	Description:	Revision:	Appendix:
N/A	Refer to E.2, Process Flow Diagrams	N/A	Public

E.2 - Process Flow Diagrams

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDPFD-10-000666-001	Process Flow Diagram Process Refrigeration Systems MR/Propane Compressors	Rev 0	P&C



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDPFD-10-000666-002	Process Flow Diagram Process Refrigeration Systems MR/Propane Compressors	Rev 0	P&C
USAL-CB-PDPFD-10-000666-003	Process Flow Diagram Process Refrigeration System MR/Propane Coolers	Rev 0	P&C
USAL-CB-PDPFD-10-000695-001	Process Flow Diagram Gas Liquefaction Systems Feed Gas Coolers and Defrost Gas Heater	Rev 0	P&C
USAL-CB-PDPFD-10-000695-002	Process Flow Diagram Gas Liquefaction System Scrub Column and Main Cryogenic Heat Exchanger	Rev 0	P&C
USAL-CB-PDPFD-50-000623-001	Process Flow Diagram Separation and Stabilization Inlet Receiving and Treatment System	Rev 2	P&C
USAL-CB-PDPFD-50-000631-001	Process Flow Diagram LPG Fractionation System Deethanizer And Depropanizer	Rev 0	P&C
USAL-CB-PDPFD-50-000631-002	Process Flow Diagram LPG Fractionation System Debutanizer	Rev 0	P&C
USAL-CB-PDPFD-50-000661-001	Process Flow Diagram Gas Treatment and Conditioning Gas Dehydration And Regeneration Gas System	Rev 1	P&C
USAL-CB-PDPFD-50-000669-001	Process Flow Diagram Gas Treatment and Conditioning Mercury Removal System	Rev 1	P&C
USAL-CB-PDPFD-70-000612-001	Process Flow Diagram Flare and Vent System Dry Flare Collection	Rev 1	P&C
USAL-CB-PDPFD-70-000612-002	Process Flow Diagram Flare and Vent System Wet Flare Collection	Rev 2	P&C
USAL-CB-PDPFD-70-000612-003	Process Flow Diagram Flare and Vent System Wet And Dry Flare	Rev 1	P&C
USAL-CB-PDPFD-70-000634-001	Process Flow Diagram Condensate Storage And Loading	Rev 1	P&C
USAL-CB-PDPFD-70-000698-001	Process Flow Diagram Refrigerant Storage Unit Ethane Refrigerant Storage	Rev 0	P&C
USAL-CB-PDPFD-70-000698-002	Process Flow Diagram Refrigerant Storage Unit Propane Refrigerant Storage	Rev 1	P&C
USAL-CB-PDPFD-80-000613-001	Process Flow Diagram Flare and Vent System LP Flare	Rev 1	P&C
USAL-CB-PDPFD-80-000691-001	Process Flow Diagram LNG Storage and Loading System Storage Tanks	Rev 1	P&C
USAL-CB-PDPFD-80-000691-002	Process Flow Diagram LNG Storage And Loading System BOG Compressors	Rev 1	P&C
USAL-CB-PDPFD-80-000691-003	Process Flow Diagram LNG Storage And Loading System Loading Arms - Berth1/2	Rev 1	P&C



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E.3 - Utility Flow Diagrams

Description:	Revision:	Appendix:
Utility Flow Diagram LP Fuel Gas System	Rev 1	P&C
Utility Flow Diagram HP Fuel Gas System	Rev 0	P&C
Utility Flow Diagram HP Fuel Gas System HP Fuel Gas For Gas Turbine Drivers	Rev 1	P&C
Utility Flow Diagram Water Systems Firewater	Rev 1	P&C
Utility Flow Diagram Water Systems Firewater Distribution	Rev 2	P&C
Utility Flow Diagram Power Generation System Gas Turbine Generator 1/2 & Heat Recovery Steam Generator 1/2 (HRSG 1/2)	Rev 1	P&C
Utility Flow Diagram Power Generation System Steam Turbine Generator 1	Rev 1	P&C
Utility Flow Diagram Power Generation System Blowdown System 1	Rev 1	P&C
Utility Flow Diagram Power Generation System Common Boiler Water Treatment	Rev 1	P&C
Utility Flow Diagram Power Generation System Common Steam Condensate Collection System	Rev 1	P&C
Utility Flow Diagram Power Generation System Common Steam Condensate Storage System	Rev 1	P&C
Utility Flow Diagram Air Systems Air Dryers, Filters and Receivers	Rev 0	P&C
Utility Flow Diagram Utility Support Systems Purge Nitrogen System	Rev 0	P&C
Utility Flow Diagram Fresh Water and Sanitary Systems Fresh Water Intaking	Rev 0	P&C
Utility Flow Diagram Fresh Water and Sanitary Systems Fresh Water Pretreatment	Rev 0	P&C
Utility Flow Diagram Fresh Water and Sanitary Systems Reverse Osmosis	Rev 0	P&C
Utility Flow Diagram Fresh Water and Sanitary Systems Potable Water Systems	Rev 0	P&C
Utility Flow Diagram Fresh Water and Sanitary Systems Demineralized Water	Rev 1	P&C
Utility Flow Diagram Steam Generation LP Steam Header	Rev 1	P&C
	Utility Flow Diagram HP Fuel Gas System Utility Flow Diagram HP Fuel Gas System HP Fuel Gas For Gas Turbine Drivers Utility Flow Diagram Water Systems Firewater Utility Flow Diagram Water Systems Firewater Distribution Utility Flow Diagram Power Generation System Gas Turbine Generator 1/2 & Heat Recovery Steam Generator 1/2 (HRSG 1/2) Utility Flow Diagram Power Generation System Steam Turbine Generator 1 Utility Flow Diagram Power Generation System Blowdown System 1 Utility Flow Diagram Power Generation System Common Boiler Water Treatment Utility Flow Diagram Power Generation System Common Steam Condensate Collection System Utility Flow Diagram Power Generation System Common Steam Condensate Storage System Utility Flow Diagram Air Systems Air Dryers, Filters and Receivers Utility Flow Diagram Hesh Water and Sanitary Systems Fresh Water Intaking Utility Flow Diagram Fresh Water and Sanitary Systems Fresh Water And Sanitary Systems Fresh Water And Sanitary Systems Reverse Osmosis Utility Flow Diagram Fresh Water and Sanitary Systems Reverse Osmosis Utility Flow Diagram Fresh Water and Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water and Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water And Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water And Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water And Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water And Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water And Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water And Sanitary Systems Potable Water Systems Utility Flow Diagram Fresh Water And Sanitary Systems Potable Water Systems	Utility Flow Diagram HP Fuel Gas System HP Fuel Gas For Gas Turbine Drivers Rev 1 Utility Flow Diagram Water Systems Firewater Distribution Rev 2 Utility Flow Diagram Power Generation System Gas Turbine Generator 1/2 & Heat Recovery Steam Generator 1/2 (HRSG 1/2) Utility Flow Diagram Power Generation System Steam Turbine Generator 1 Utility Flow Diagram Power Generation System Blowdown System 1 Utility Flow Diagram Power Generation System Common Boiler Water Treatment Utility Flow Diagram Power Generation System Common Steam Condensate Collection System Utility Flow Diagram Power Generation System Common Steam Condensate Storage System Utility Flow Diagram Power Generation System Common Steam Condensate Storage System Utility Flow Diagram Power Generation System Common Steam Condensate Storage System Utility Flow Diagram Power Generation System Common Steam Condensate Storage System Utility Flow Diagram Power Generation System System Systems Purge Nitrogen System Rev 0 Utility Flow Diagram Fresh Water and Sanitary Systems Fresh Water Intaking Utility Flow Diagram Fresh Water and Sanitary Systems Reverse Osmosis Rev 0 Utility Flow Diagram Fresh Water and Sanitary Systems Reverse Osmosis Rev 0 Utility Flow Diagram Fresh Water and Sanitary Systems Potable Water Systems Pretreatment Utility Flow Diagram Fresh Water and Sanitary Systems Potable Water Systems Rev 0 Utility Flow Diagram Fresh Water and Sanitary Systems Demineralized Water Rev 0 Utility Flow Diagram Fresh Water and Sanitary Systems Demineralized Water Utility Flow Diagram Fresh Water and Sanitary Systems Demineralized Water Utility Flow Diagram Fresh Water and Sanitary Systems Demineralized Water



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDUFD-70-000911-001	Utility Flow Diagram Liquid Fuel Systems Diesel Oil Storage and Distribution System	Rev 2	P&C
USAL-CB-PDUFD-70-000964-001	Utility Flow Diagram Utility Support Systems Sludge and Waste Oil Handling	Rev 0	P&C
USAL-CB-PDUFD-70-000997-001	Utility Flow Diagram Bilge, Drainage and Vents PCSW Collection System	Rev 1	P&C
USAL-CB-PDUFD-70-000997-002	Utility Flow Diagram Bilge, Drainage and Vents Oily Waste Water Pre-Separation Treatment System	Rev 0	P&C
USAL-CB-PDUFD-70-000997-003	Utility Flow Diagram Bilge, Drainage and Vents Oily Waste Water/DAF Treatment System	Rev 1	P&C
USAL-CB-PDUFD-70-000998-001	Utility Flow Diagram Bilge, Drainage and Vents Process Spill Collection System	Rev 2	P&C
USAL-CB-PDUFD-70-000998-002	Utility Flow Diagram Bilge, Drainage and Vents Process Spill Collection System	Rev 2	P&C
USAL-CB-PDUFD-00-000973-001	Utility Flow Diagram Fresh Water and Sanitary Systems Sanitary Waste Water Collection and Treatment	Rev 0	P&C

E.4 - Heat and Material Balances

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PCCAL-00-000101-000	Heat and Material Balance Case 1 - Average Gas Winter Ambient Holding Mode	Rev 0	P&C
USAL-CB-PCCAL-00-000102-000	Heat and Material Balance Case 2 - Average Gas Average Ambient Holding Mode	Rev 0	P&C
USAL-CB-PCCAL-00-000103-000	Heat and Material Balance Case 3 - Average Gas High Ambient Holding Mode	Rev 0	P&C
USAL-CB-PCCAL-00-000104-000	Heat and Material Balance Case 4 - 100% PBU Average Ambient Holding Mode	Rev 0	P&C
USAL-CB-PCCAL-00-000105-000	Heat and Material Balance Case 5 - 100% PTU Average Ambient Holding Mode	Rev 0	P&C
USAL-CB-PCCAL-00-000106-000	Heat and Material Balance Case 6 - Average Gas Average Ambient Loading Mode	Rev 0	P&C

E.5 - Piping and Instrument Diagrams

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FDPID-00-000411-001	Piping & Instrumentation Diagram Firewater Pumps	Rev 0	P&C



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-FDPID-00-000411-002	Piping & Instrumentation Diagram Firewater Storage And Jockey Pumps	Rev 0	P&C
USAL-CB-FDPID-00-000412-001	Piping & Instrumentation Diagram Firewater Distribution System Common Process / Utilities / Condensate & Diesel Oil Stg. / Buildings	Rev 0	P&C
USAL-CB-FDPID-00-000412-002	Piping & Instrumentation Diagram Firewater Distribution System LNG Process Train 1/2/3	Rev 0	P&C
USAL-CB-FDPID-00-000412-003	Piping & Instrumentation Diagram Firewater Distribution System LNG Storage / REF. Storage / BOG / Fractionation / AIR & Nitrogen / Jetty	Rev 0	P&C
USAL-CB-PDPID-00-000000-051	Piping & Instrumentation Diagram Process Piping Interconnecting Diagram Inlet, Fuel, Flare, Water System & Power Generation Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-052	Piping & Instrumentation Diagram Process Piping Interconnecting Diagram Utility & Storage Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-053	Piping & Instrumentation Diagram Process Piping Interconnecting Diagram Train 1 & Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-054	Piping & Instrumentation Diagram Process Piping Interconnecting Diagram LNG Tank, Train 2 & 3 Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-055	Piping & Instrumentation Diagram Process Piping Interconnecting Diagram Trestle, LP Flare & BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-056	Piping & Instrumentation Diagram Utility Piping Interconnecting Diagram Inlet, Fuel, Flare, Water System & Power Generation Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-057	Piping & Instrumentation Diagram Utility Piping Interconnecting Diagram Utility & Storage Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-058	Piping & Instrumentation Diagram Utility Piping Interconnecting Diagram Train 1 & Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-059	Piping & Instrumentation Diagram Utility Piping Interconnecting Diagram LNG Tank, Train 2 & 3 Area	Rev 0	P&C
USAL-CB-PDPID-00-000000-060	Piping & Instrumentation Diagram Utility Piping Interconnecting Diagram Trestle, LP Flare & BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-10-000612-101	Piping & Instrumentation Diagram HP Flare System Dry Flare Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000612-111	Piping & Instrumentation Diagram HP Flare System Wet Flare Header - Train 1	Rev 0	P&C



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USAL-CB-PDPID-10-000612-121	Piping & Instrumentation Diagram HP Flare System Dry Liquid Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000613-101	Piping & Instrumentation Diagram LP Flare System LP Flare Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000661-101	Piping & Instrumentation Diagram Gas Dehydration System Defrost Gas Heater	Rev 0	P&C
USAL-CB-PDPID-10-000661-102	Piping & Instrumentation Diagram Gas Dehydration System Defrost Gas Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-101	Piping and Instrumentation Diagram Process Refrigeration Systems MR Return Line From Cryogenic Heat Exchanger	Rev 1	P&C
USAL-CB-PDPID-10-000666-111	Piping & Instrumentation Diagram Process Refrigeration Systems LP MR Comp. Suc. Drum And LP MR Comp String 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-112	Piping & Instrumentation Diagram Process Refrigeration Systems LP MR Comp. Intercooler And MP MR Comp. Suc. Drum - String 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-113	Piping & Instrumentation Diagram Process Refrigeration Systems MP MR Compressor And Intercooler - String 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-114	Piping & Instrumentation Diagram Process Refrigeration Systems HP MR Comp. Suc. Drum And HP MR Comp String 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-115	Piping & Instrumentation Diagram Process Refrigeration Systems HP MR Comp. Desuperheater And After-Cooler - String 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-131	Piping & Instrumentation Diagram Process Refrigeration Systems MR HP/MP Propane Cooler	Rev 0	P&C
USAL-CB-PDPID-10-000666-132	Piping & Instrumentation Diagram Process Refrigeration Systems MR/LP Propane Cooler	Rev 0	P&C
USAL-CB-PDPID-10-000666-133	Piping & Instrumentation Diagram Process Refrigeration Systems HP MR Separator	Rev 1	P&C
USAL-CB-PDPID-10-000666-134	Piping & Instrumentation Diagram Process Refrigeration Systems MR Hydraulic Turbine	Rev 0	P&C
USAL-CB-PDPID-10-000666-141	Piping & Instrumentation Diagram Process Refrigeration Systems LP/MP Propane Suction Drum - String 1	Rev 1	P&C
USAL-CB-PDPID-10-000666-142	Piping & Instrumentation Diagram Process Refrigeration Systems HP Propane Suction Drum - String 1	Rev 1	P&C



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USAL-CB-PDPID-10-000666-143	Piping & Instrumentation Diagram Process Refrigeration Systems Propane Refrigerant Compressor - String 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-144	Piping & Instrumentation Diagram Process Refrigeration Systems Propane Desuperheater - String 1	Rev 0	P&C
USAL-CB-PDPID-10-000666-161	Piping & Instrumentation Diagram Process Refrigeration Systems Propane Condenser And Propane Accumulator	Rev 0	P&C
USAL-CB-PDPID-10-000666-162	Piping & Instrumentation Diagram Process Refrigeration Systems Propane Subcooler, Propane Transfer Drum And Pump	Rev 0	P&C
USAL-CB-PDPID-10-000666-163	Piping & Instrumentation Diagram Process Refrigeration Systems Propane Drain Connections	Rev 1	P&C
USAL-CB-PDPID-10-000666-171	Piping & Instrumentation Diagram Process Refrigeration Systems MR/PR Compressor Gas Turbine Driver - String 1	Rev 1	P&C
USAL-CB-PDPID-10-000695-101	Piping & Instrumentation Diagram Gas Liquefaction System Feed Gas Propane Coolers	Rev 0	P&C
USAL-CB-PDPID-10-000695-102	Piping & Instrumentation Diagram Gas Liquefaction System Scrub Column	Rev 0	P&C
USAL-CB-PDPID-10-000695-103	Piping & Instrumentation Diagram Gas Liquefaction System Main Cryogenic Heat Exchanger (LNG)	Rev 0	P&C
USAL-CB-PDPID-10-000695-104	Piping & Instrumentation Diagram Gas Liquefaction System Scrub Column Reflux Drum And Pumps	Rev 0	P&C
USAL-CB-PDPID-10-000695-105	Piping & Instrumentation Diagram Gas Liquefaction System LNG Hydraulic Turbine	Rev 0	P&C
USAL-CB-PDPID-10-000695-106	Piping & Instrumentation Diagram Gas Liquefaction System Scrub Column Cooler	Rev 0	P&C
USAL-CB-PDPID-10-000695-107	Piping & Instrumentation Diagram Gas Liquefaction System Main Cryogenic Heat Exchanger (MR)	Rev 0	P&C
USAL-CB-PDPID-10-000951-101	Piping & Instrumentation Diagram Utility/Service Air Distribution System Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000952-101	Piping & Instrumentation Diagram Instrument Air Distribution System Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000961-101	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Train 1	Rev 0	P&C



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USAL-CB-PDPID-10-000966-101	Piping & Instrumentation Diagram HP Fuel Gas System Fuel Gas Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000973-101	Piping & Instrumentation Diagram Sanitary Waste Water Collection and Treatment Sanitary Lift Station - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000976-101	Piping & Instrumentation Diagram Fresh Water and Sanitary System Utility Water Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000977-101	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000979-101	Piping & Instrumentation Diagram Demineralized Water System Demineralized Water Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000991-101	Piping & Instrumentation Diagram Oil Closed Drain System Oil Sump and Pumps - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000997-101	Piping & Instrumentation Diagram Oily Waste Water Collection and Treatment System PCSW Collection Sumps and Pumps - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000997-102	Piping & Instrumentation Diagram Oily Waste Water Collection and Treatment System PCSW Collection Header - Train 1	Rev 0	P&C
USAL-CB-PDPID-10-000998-101	Piping & Instrumentation Diagram Onshore Drainage and Discharge System Impoundment Sumps and Pumps - Train 1	Rev 0	P&C
USAL-CB-PDPID-50-000612-501	Piping & Instrumentation Diagram HP Flare System Dry Flare Header - Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000612-502	Piping & Instrumentation Diagram HP Flare System Dry Flare Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000612-503	Piping & Instrumentation Diagram HP Flare System Dry Flare Header - HP & LP Fuel Gas Area	Rev 0	P&C
USAL-CB-PDPID-50-000612-511	Piping & Instrumentation Diagram HP Flare System Wet Flare Header - Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000612-512	Piping & Instrumentation Diagram HP Flare System Wet Flare Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000612-513	Piping & Instrumentation Diagram HP Flare System Wet Flare Header - HP & LP Fuel Gas Area	Rev 0	P&C
USAL-CB-PDPID-50-000612-522	Piping & Instrumentation Diagram HP Flare System Dry Liquid Header - Fractionation Area	Rev 0	P&C



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDPID-50-000623-501	Piping & Instrumentation Diagram Inlet Receiving & Treatment System Inlet Gas Filters	Rev 0	P&C
USAL-CB-PDPID-50-000623-502	Piping & Instrumentation Diagram Inlet Receiving & Treatment System Inlet Gas Heater	Rev 0	P&C
USAL-CB-PDPID-50-000623-503	Piping & Instrumentation Diagram Inlet Receiving & Treatment System Pressure Letdown Station	Rev 0	P&C
USAL-CB-PDPID-50-000623-504	Piping & Instrumentation Diagram Inlet Receiving & Treatment System Inlet Gas Heater Condensate Pot	Rev 0	P&C
USAL-CB-PDPID-50-000631-501	Piping & Instrumentation Diagram LPG Fractionation System Fractionation Feed Separator	Rev 0	P&C
USAL-CB-PDPID-50-000631-502	Piping & Instrumentation Diagram LPG Fractionation System Deethanizer Column	Rev 0	P&C
USAL-CB-PDPID-50-000631-503	Piping & Instrumentation Diagram LPG Fractionation System Deethanizer Reboiler And Condensate Pot	Rev 0	P&C
USAL-CB-PDPID-50-000631-504	Piping & Instrumentation Diagram LPG Fractionation System Deethanizer Condenser	Rev 0	P&C
USAL-CB-PDPID-50-000631-505	Piping & Instrumentation Diagram LPG Fractionation System Deethanizer Reflux Drum And Pumps	Rev 0	P&C
USAL-CB-PDPID-50-000631-511	Piping & Instrumentation Diagram LPG Fractionation System Depropanizer Column	Rev 0	P&C
USAL-CB-PDPID-50-000631-512	Piping & Instrumentation Diagram LPG Fractionation System Depropanizer Reboiler And Condensate Pot	Rev 0	P&C
USAL-CB-PDPID-50-000631-513	Piping & Instrumentation Diagram LPG Fractionation System Depropanizer Condenser And Reflux Pumps	Rev 0	P&C
USAL-CB-PDPID-50-000631-514	Piping & Instrumentation Diagram LPG Fractionation System Depropanizer Reflux Drum And Reinjection Pumps	Rev 0	P&C
USAL-CB-PDPID-50-000631-521	Piping & Instrumentation Diagram LPG Fractionation System Debutanizer Column	Rev 0	P&C
USAL-CB-PDPID-50-000631-522	Piping & Instrumentation Diagram LPG Fractionation System Debutanizer Reboiler And Condensate Pot	Rev 0	P&C
USAL-CB-PDPID-50-000631-523	Piping & Instrumentation Diagram LPG Fractionation System Debutanizer Condenser And Reflux Pumps	Rev 0	P&C
USAL-CB-PDPID-50-000631-524	Piping & Instrumentation Diagram LPG Fractionation System Debutanizer Reflux Drum And Reinjection Pumps	Rev 0	P&C



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDPID-50-000631-525	Piping & Instrumentation Diagram LPG Fractionation System LPG Reinjection Cooler	Rev 0	P&C
USAL-CB-PDPID-50-000631-526	Piping & Instrumentation Diagram LPG Fractionation System LPG Reinjection KO Drum And Reinjection Pumps	Rev 0	P&C
USAL-CB-PDPID-50-000631-527	Piping & Instrumentation Diagram LPG Fractionation System Debutanizer Condensate Product Cooler	Rev 0	P&C
USAL-CB-PDPID-50-000661-501	Piping & Instrumentation Diagram Gas Dehydration System Molecular Sieve Dryers Inlet/Outlet	Rev 0	P&C
USAL-CB-PDPID-50-000661-502	Piping & Instrumentation Diagram Gas Dehydration System Molecular Sieve Dryer 1, 2	Rev 0	P&C
USAL-CB-PDPID-50-000661-505	Piping & Instrumentation Diagram Gas Dehydration System Molecular Sieve Dryer After Filters	Rev 0	P&C
USAL-CB-PDPID-50-000661-506	Piping & Instrumentation Diagram Gas Dehydration System Regeneration Gas Heaters	Rev 0	P&C
USAL-CB-PDPID-50-000661-507	Piping & Instrumentation Diagram Gas Dehydration System Regeneration Gas Cooler and KO Drum	Rev 0	P&C
USAL-CB-PDPID-50-000661-511	Piping & Instrumentation Diagram Gas Dehydration System Defrost Gas Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000669-501	Piping & Instrumentation Diagram Mercury Removal System Inlet Gas Separator And Mercury Adsorber 1	Rev 0	P&C
USAL-CB-PDPID-50-000669-504	Piping & Instrumentation Diagram Mercury Removal System Mercury Adsorber After Filters	Rev 0	P&C
USAL-CB-PDPID-50-000951-501	Piping & Instrumentation Diagram Utility/Service Air Distribution System Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000951-502	Piping & Instrumentation Diagram Utility/Service Air Distribution System Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000952-501	Piping & Instrumentation Diagram Instrument Air Distribution System Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000952-502	Piping & Instrumentation Diagram Instrument Air Distribution System Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000961-501	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000961-502	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Fractionation Area	Rev 0	P&C



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USAL-CB-PDPID-50-000965-501	Piping & Instrumentation Diagram LP Fuel Gas System LP Fuel Gas Drum	Rev 0	P&C
USAL-CB-PDPID-50-000966-501	Piping & Instrumentation Diagram HP Fuel Gas System Start-Up Fuel Gas Filter and Heater	Rev 0	P&C
USAL-CB-PDPID-50-000966-502	Piping & Instrumentation Diagram HP Fuel Gas System HP Fuel Gas Mixing Drum and Heater	Rev 0	P&C
USAL-CB-PDPID-50-000966-503	Piping & Instrumentation Diagram HP Fuel Gas System Excess LPG Vaporizer	Rev 0	P&C
USAL-CB-PDPID-50-000966-504	Piping & Instrumentation Diagram HP Fuel Gas System BOG Recycle Compressor and Aftercooler	Rev 0	P&C
USAL-CB-PDPID-50-000966-505	Piping & Instrumentation Diagram HP Fuel Gas System HP Fuel Gas Heater Condensate Pot	Rev 0	P&C
USAL-CB-PDPID-50-000966-551	Piping & Instrumentation Diagram HP Fuel Gas System Fuel Gas Header - Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000966-552	Piping & Instrumentation Diagram HP Fuel Gas System Fuel Gas Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000976-501	Piping & Instrumentation Diagram Fresh Water and Sanitary System Utility Water Header - Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000976-502	Piping & Instrumentation Diagram Fresh Water and Sanitary System Utility Water Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000977-501	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Inlet Gas Treating Area	Rev 0	P&C
USAL-CB-PDPID-50-000977-502	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000984-502	Piping & Instrumentation Diagram LP Steam System/Handling LP Steam Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000987-502	Piping & Instrumentation Diagram Steam Condensate System Steam Condensate Header - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-50-000997-501	Piping & Instrumentation Diagram Oily Waste Water Collection and Treatment System PCSW Collection Sump and Pumps - Metering Area	Rev 0	P&C
USAL-CB-PDPID-50-000997-502	Piping & Instrumentation Diagram Oily Waste Water Collection and Treatment System PCSW Collection Sump and Pumps - Inlet Gas Treating Area	Rev 0	P&C



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USAL-CB-PDPID-50-000998-501	Piping & Instrumentation Diagram Onshore Drainage and Discharge System Impoundment Sumps and Pumps - Fractionation Area	Rev 0	P&C
USAL-CB-PDPID-60-000833-601	Piping & Instrumentation Diagram Power Generation System (Main Generation) GTG/HRSG Packages 1, 2 Pipework	Rev 0	P&C
USAL-CB-PDPID-60-000833-602	Piping & Instrumentation Diagram Power Generation System (Main Generation) GTG/HRSG Package 1	Rev 0	P&C
USAL-CB-PDPID-60-000948-601	Piping & Instrumentation Diagram Boilers Blowdown Cooler 1	Rev 0	P&C
USAL-CB-PDPID-60-000951-601	Piping & Instrumentation Diagram Utility/Service Air Distribution System Utility Area	Rev 0	P&C
USAL-CB-PDPID-60-000951-602	Piping & Instrumentation Diagram Utility/Service Air Distribution System Flare & Water System Area	Rev 0	P&C
USAL-CB-PDPID-60-000952-601	Piping & Instrumentation Diagram Instrument Air Distribution System Utility Area	Rev 0	P&C
USAL-CB-PDPID-60-000952-602	Piping & Instrumentation Diagram Instrument Air Distribution System Flare & Water System Area	Rev 0	P&C
USAL-CB-PDPID-60-000955-601	Piping & Instrumentation Diagram Air Compressors Air Compressor Package	Rev 0	P&C
USAL-CB-PDPID-60-000956-601	Piping & Instrumentation Diagram Air Dryers, Filters and Receivers Compressed Air Receiver	Rev 0	P&C
USAL-CB-PDPID-60-000956-602	Piping & Instrumentation Diagram Air Dryers, Filters and Receivers Instrument Air Dryer Package	Rev 0	P&C
USAL-CB-PDPID-60-000956-603	Piping & Instrumentation Diagram Air Dryers, Filters and Receivers Instrument Air Receiver	Rev 0	P&C
USAL-CB-PDPID-60-000961-601	Piping & Instrumentation Diagram Nitrogen System High Purity Cryogenic Nitrogen Generation Package	Rev 0	P&C
USAL-CB-PDPID-60-000961-602	Piping & Instrumentation Diagram Nitrogen System High Purity Liquid Nitrogen Storage & Vaporizer Package	Rev 0	P&C
USAL-CB-PDPID-60-000961-603	Piping & Instrumentation Diagram Nitrogen System Piping Work	Rev 0	P&C
USAL-CB-PDPID-60-000961-604	Piping & Instrumentation Diagram Nitrogen System Purge Nitrogen Generation Packages	Rev 0	P&C
USAL-CB-PDPID-60-000961-605	Piping & Instrumentation Diagram Nitrogen System Nitrogen Receiver	Rev 0	P&C



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USAL-CB-PDPID-60-000961-651	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Utility Area	Rev 0	P&C
USAL-CB-PDPID-60-000961-652	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Flare & Water System Area	Rev 0	P&C
USAL-CB-PDPID-60-000964-601	Piping & Instrumentation Diagram Slop Oil System CPI Sludge Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000964-602	Piping & Instrumentation Diagram Slop Oil System CPI Slop Oil Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000964-603	Piping & Instrumentation Diagram Slop Oil System Slop Oil Tank and Slop Oil Transfer Pump	Rev 0	P&C
USAL-CB-PDPID-60-000966-601	Piping & Instrumentation Diagram HP Fuel Gas System Fuel Gas Header - Flare & Water System Area	Rev 0	P&C
USAL-CB-PDPID-60-000973-601	Piping & Instrumentation Diagram Sanitary Waste Water Collection and Treatment Sanitary Lift Station - Utilities	Rev 0	P&C
USAL-CB-PDPID-60-000973-602	Piping & Instrumentation Diagram Sanitary Waste Water Collection and Treatment Sanitary Lift Station - Power Generation	Rev 0	P&C
USAL-CB-PDPID-60-000973-603	Piping & Instrumentation Diagram Sanitary Waste Water Collection and Treatment Sanitary Treatment Package	Rev 0	P&C
USAL-CB-PDPID-60-000976-601	Piping & Instrumentation Diagram Fresh Water and Sanitary System Well Pumps PBA976601/41	Rev 0	P&C
USAL-CB-PDPID-60-000976-602	Piping & Instrumentation Diagram Fresh Water and Sanitary System Well Pumps PBA976602/42	Rev 0	P&C
USAL-CB-PDPID-60-000976-603	Piping & Instrumentation Diagram Fresh Water and Sanitary System Fresh Water Tank BBJ976605	Rev 0	P&C
USAL-CB-PDPID-60-000976-604	Piping & Instrumentation Diagram Fresh Water and Sanitary System Fresh Water Tank BBJ976606	Rev 0	P&C
USAL-CB-PDPID-60-000976-605	Piping & Instrumentation Diagram Fresh Water and Sanitary System Fresh Water Tank Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000976-606	Piping & Instrumentation Diagram Fresh Water and Sanitary System Fresh Water Pre-Heater and Condensate Pot	Rev 0	P&C
USAL-CB-PDPID-60-000976-607	Piping & Instrumentation Diagram Fresh Water and Sanitary System Fire Water Make Up Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000976-608	Piping & Instrumentation Diagram Fresh Water and Sanitary System Clarification and Filter Press Package	Rev 0	P&C



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USAL-CB-PDPID-60-000976-609	Piping & Instrumentation Diagram Fresh Water and Sanitary System Clarified Water Clearwell Tank	Rev 0	P&C
USAL-CB-PDPID-60-000976-610	Piping & Instrumentation Diagram Fresh Water and Sanitary System Clarified Water Forwarding Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000976-611	Piping & Instrumentation Diagram Fresh Water and Sanitary System Water Purification UF Package	Rev 0	P&C
USAL-CB-PDPID-60-000976-612	Piping & Instrumentation Diagram Fresh Water and Sanitary System Filtered Water Storage Tank	Rev 0	P&C
USAL-CB-PDPID-60-000976-613	Piping & Instrumentation Diagram Fresh Water and Sanitary System Filtered Water Forwarding Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000976-614	Piping & Instrumentation Diagram Fresh Water and Sanitary System Reclaimed Water Sump and Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000976-615	Piping & Instrumentation Diagram Fresh Water and Sanitary System Reverse Osmosis Package	Rev 0	P&C
USAL-CB-PDPID-60-000976-616	Piping & Instrumentation Diagram Fresh Water and Sanitary System CIP System	Rev 0	P&C
USAL-CB-PDPID-60-000976-651	Piping & Instrumentation Diagram Fresh Water and Sanitary System Utility Water Header - Utility Area	Rev 0	P&C
USAL-CB-PDPID-60-000976-652	Piping & Instrumentation Diagram Fresh Water and Sanitary System Utility Water Header - Flare & Water System Area	Rev 0	P&C
USAL-CB-PDPID-60-000977-601	Piping & Instrumentation Diagram Potable Water System RO Permeate Tank	Rev 0	P&C
USAL-CB-PDPID-60-000977-602	Piping & Instrumentation Diagram Potable Water System RO Permeate Forwarding Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000977-603	Piping & Instrumentation Diagram Potable Water System Activated Carbon Cartridge Filters	Rev 0	P&C
USAL-CB-PDPID-60-000977-604	Piping & Instrumentation Diagram Potable Water System Potable Water Package	Rev 0	P&C
USAL-CB-PDPID-60-000977-605	Piping & Instrumentation Diagram Potable Water System Potable Water Storage Tank	Rev 0	P&C
USAL-CB-PDPID-60-000977-606	Piping & Instrumentation Diagram Potable Water System Potable Water Forwarding Pumps	Rev 0	P&C



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USAL-CB-PDPID-60-000977-607	Piping & Instrumentation Diagram Potable Water System Sodium Hypochlorite Generator Package and Distribution Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000977-651	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Utility Area	Rev 0	P&C
USAL-CB-PDPID-60-000977-652	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Flare & Water System Area	Rev 0	P&C
USAL-CB-PDPID-60-000979-601	Piping & Instrumentation Diagram Demineralized Water System Demineralization Package	Rev 0	P&C
USAL-CB-PDPID-60-000979-602	Piping & Instrumentation Diagram Demineralized Water System Demineralized Water Storage Tank	Rev 0	P&C
USAL-CB-PDPID-60-000979-603	Piping & Instrumentation Diagram Demineralized Water System Demineralized Water Forwarding Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000979-604	Piping & Instrumentation Diagram Demineralized Water System Neutralization Package	Rev 0	P&C
USAL-CB-PDPID-60-000979-605	Piping & Instrumentation Diagram Demineralized Water System Chemical Sump and Lift Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000987-601	Piping & Instrumentation Diagram Steam Condensate System LP Steam Dump Condenser	Rev 0	P&C
USAL-CB-PDPID-60-000987-602	Piping & Instrumentation Diagram Steam Condensate System LP Condensate Separator and LP Steam Condenser	Rev 0	P&C
USAL-CB-PDPID-60-000987-603	Piping & Instrumentation Diagram Steam Condensate System LP Condensate Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000987-604	Piping & Instrumentation Diagram Steam Condensate System Demin/Condensate Exchanger and Steam Condensate Cooler	Rev 0	P&C
USAL-CB-PDPID-60-000987-605	Piping & Instrumentation Diagram Steam Condensate System Condensate Activated Carbon Filters	Rev 0	P&C
USAL-CB-PDPID-60-000987-606	Piping & Instrumentation Diagram Steam Condensate System Steam Condensate Tank	Rev 0	P&C
USAL-CB-PDPID-60-000987-607	Piping & Instrumentation Diagram Steam Condensate System Steam Condensate Tank Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000987-608	Piping & Instrumentation Diagram Steam Condensate System Contaminated Condensate Cooler	Rev 0	P&C



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USAL-CB-PDPID-60-000991-601	Piping & Instrumentation Diagram Oil Closed Drain System Oil Sumps and Pumps - Power Generation	Rev 0	P&C
USAL-CB-PDPID-60-000997-601	Piping & Instrumentation Diagram Oily Waste Water Collection and Treatment System PCSW Collection Sumps and Pumps - Power Generation	Rev 0	P&C
USAL-CB-PDPID-60-000997-602	Piping & Instrumentation Diagram Oily Waste Water Collection and Treatment System PCSW Collection Header - Power Generation	Rev 0	P&C
USAL-CB-PDPID-60-000997-606	Piping & Instrumentation Diagram Oily Wastewater Collection and Treatment System Equalization Tank and Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000997-607	Piping & Instrumentation Diagram Oily Wastewater Collection and Treatment System CPI Separator Package	Rev 0	P&C
USAL-CB-PDPID-60-000997-608	Piping & Instrumentation Diagram Oily Wastewater Collection and Treatment System DGF Package and Flotation Unit Sludge Pumps	Rev 0	P&C
USAL-CB-PDPID-60-000997-609	Piping & Instrumentation Diagram Oily Wastewater Collection and Treatment System Observation Basin and Pumps	Rev 0	P&C
USAL-CB-PDPID-70-000612-701	Piping & Instrumentation Diagram HP Flare System Dry Flare Header - Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000612-721	Piping & Instrumentation Diagram HP Flare System Dry Liquid Header - Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000612-731	Piping & Instrumentation Diagram HP Flare System Dry Flare KO Drum	Rev 0	P&C
USAL-CB-PDPID-70-000612-732	Piping & Instrumentation Diagram HP Flare System Wet Flare KO Drum	Rev 0	P&C
USAL-CB-PDPID-70-000612-733	Piping & Instrumentation Diagram HP Flare System Scrub Column Bottoms Vaporizer	Rev 0	P&C
USAL-CB-PDPID-70-000612-734	Piping & Instrumentation Diagram HP Flare System Wet and Dry Ground Flares A	Rev 0	P&C
USAL-CB-PDPID-70-000634-701	Piping & Instrumentation Diagram Condensate Storage and Loading System Condensate Storage Tank	Rev 0	P&C
USAL-CB-PDPID-70-000634-702	Piping & Instrumentation Diagram Condensate Storage and Loading System Condensate Loading Pumps	Rev 0	P&C
USAL-CB-PDPID-70-000634-703	Piping & Instrumentation Diagram Condensate Storage and Loading System Condensate Truck Loading	Rev 0	P&C



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USAL-CB-PDPID-70-000634-704	Piping & Instrumentation Diagram Condensate Storage and Loading System Offspec Condensate Storage Tank	Rev 0	P&C
USAL-CB-PDPID-70-000634-705	Piping & Instrumentation Diagram Condensate Storage and Loading System Offspec Condensate Pump	Rev 0	P&C
USAL-CB-PDPID-70-000634-706	Piping & Instrumentation Diagram Condensate Storage and Loading System Vent KO Drum and Process Blowers	Rev 0	P&C
USAL-CB-PDPID-70-000634-707	Piping & Instrumentation Diagram Condensate Storage and Loading System Thermal Oxidizer	Rev 0	P&C
USAL-CB-PDPID-70-000698-701	Piping & Instrumentation Diagram Refrigerant Storage System Ethane Refrigerant Storage Bullets	Rev 0	P&C
USAL-CB-PDPID-70-000698-702	Piping & Instrumentation Diagram Refrigerant Storage System Ethane Vaporizer	Rev 0	P&C
USAL-CB-PDPID-70-000698-703	Piping & Instrumentation Diagram Refrigerant Storage System Propane Refrigerant Storage Bullets 1, 2	Rev 0	P&C
USAL-CB-PDPID-70-000698-705	Piping & Instrumentation Diagram Refrigerant Storage System Propane Storage Pump	Rev 0	P&C
USAL-CB-PDPID-70-000698-706	Piping & Instrumentation Diagram Refrigerant Storage System Propane Unloading Pump	Rev 0	P&C
USAL-CB-PDPID-70-000911-701	Piping & Instrumentation Diagram Diesel Oil Storage and Distribution System Diesel Storage Tank	Rev 0	P&C
USAL-CB-PDPID-70-000911-702	Piping & Instrumentation Diagram Diesel Oil Storage and Distribution System Diesel Transfer Pumps	Rev 0	P&C
USAL-CB-PDPID-70-000951-701	Piping & Instrumentation Diagram Utility/Service Air Distribution System Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000952-701	Piping & Instrumentation Diagram Instrument Air Distribution System Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000961-701	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000966-701	Piping & Instrumentation Diagram HP Fuel Gas System Fuel Gas Header - Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000973-701	Piping & Instrumentation Diagram Sanitary Wastewater Collection and Treatment Sanitary Lift Station - Offsite Facilities Area and Infrastructure Area	Rev 0	P&C



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USAL-CB-PDPID-70-000973-702	Piping & Instrumentation Diagram Sanitary Wastewater Collection and Treatment Sanitary Lift Station - North Gate Area	Rev 0	P&C
USAL-CB-PDPID-70-000973-703	Piping & Instrumentation Diagram Sanitary Wastewater Collection and Treatment Sanitary Collection Header	Rev 0	P&C
USAL-CB-PDPID-70-000976-701	Piping & Instrumentation Diagram Freshwater and Sanitary System Utility Water Header - Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000977-701	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-70-000998-701	Piping & Instrumentation Diagram Onshore Drainage and Discharge System Impoundment Sumps and Pumps - Condensate Truck Loading Area and Refrigerant Storage Area	Rev 0	P&C
USAL-CB-PDPID-80-000613-801	Piping & Instrumentation Diagram LP Flare System LP Flare KO Drum	Rev 0	P&C
USAL-CB-PDPID-80-000613-802	Piping & Instrumentation Diagram LP Flare System Flame Front Generator for LP Flare	Rev 0	P&C
USAL-CB-PDPID-80-000613-803	Piping & Instrumentation Diagram LP Flare System LP Flare	Rev 0	P&C
USAL-CB-PDPID-80-000613-851	Piping & Instrumentation Diagram LP Flare System LP Flare Header - LNG Storage Tank Area	Rev 0	P&C
USAL-CB-PDPID-80-000613-852	Piping & Instrumentation Diagram LP Flare System LP Flare Header - BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-80-000691-801	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Storage Pipework ABJ691810	Rev 0	P&C
USAL-CB-PDPID-80-000691-802	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Storage - 1/3 ABJ691810	Rev 0	P&C
USAL-CB-PDPID-80-000691-803	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Storage - 2/3 ABJ691810	Rev 0	P&C
USAL-CB-PDPID-80-000691-804	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Storage - 3/3 ABJ691810	Rev 0	P&C
USAL-CB-PDPID-80-000691-820	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Storage Tanks Common Pipework	Rev 0	P&C
USAL-CB-PDPID-80-000691-821	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Loading Pipework - Shore	Rev 0	P&C



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDPID-80-000691-822	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Loading Pipework - Trestle	Rev 0	P&C
USAL-CB-PDPID-80-000691-830	Piping & Instrumentation Diagram LNG Storage and Loading System BOG Compressor Pipework	Rev 0	P&C
USAL-CB-PDPID-80-000691-831	Piping & Instrumentation Diagram LNG Storage and Loading System BOG Compressor Suction Drum 1/3	Rev 0	P&C
USAL-CB-PDPID-80-000691-832	Piping & Instrumentation Diagram LNG Storage and Loading System BOG Compressor and After-Cooler 1/3	Rev 0	P&C
USAL-CB-PDPID-80-000691-861	Piping & Instrumentation Diagram LNG Storage and Loading System BOG Compressor Suction Drum Blowcase	Rev 0	P&C
USAL-CB-PDPID-80-000951-801	Piping & Instrumentation Diagram Utility/Service Air Distribution System Condensate & Diesel Storage and Sanitary Treatment Area	Rev 0	P&C
USAL-CB-PDPID-80-000951-802	Piping & Instrumentation Diagram Utility/Service Air Distribution System BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-80-000951-803	Piping & Instrumentation Diagram Utility/Service Air Distribution System LP Flare Area	Rev 0	P&C
USAL-CB-PDPID-80-000951-804	Piping & Instrumentation Diagram Utility/Service Air Distribution System LNG Storage Tank Area	Rev 0	P&C
USAL-CB-PDPID-80-000952-801	Piping & Instrumentation Diagram Instrument Air Distribution System Condensate & Diesel Storage and Sanitary Treatment Area	Rev 0	P&C
USAL-CB-PDPID-80-000952-802	Piping & Instrumentation Diagram Instrument Air Distribution System BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-80-000952-803	Piping & Instrumentation Diagram Instrument Air Distribution System LP Flare Area	Rev 0	P&C
USAL-CB-PDPID-80-000952-804	Piping & Instrumentation Diagram Instrument Air Distribution System LNG Storage Tank Area	Rev 0	P&C
USAL-CB-PDPID-80-000961-801	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Condensate & Diesel Storage and Sanitary Treatment Area	Rev 0	P&C
USAL-CB-PDPID-80-000961-802	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-80-000961-803	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - LP Flare Area	Rev 0	P&C



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDPID-80-000961-804	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - LNG Storage Tank Area	Rev 0	P&C
USAL-CB-PDPID-80-000966-801	Piping & Instrumentation Diagram HP Fuel Gas System Fuel Gas Header - LNG Storage Tank Area	Rev 0	P&C
USAL-CB-PDPID-80-000973-801	Piping & Instrumentation Diagram Sanitary Wastewater Collection and Treatment Sanitary Lift Station - Storage and Loading Area	Rev 0	P&C
USAL-CB-PDPID-80-000976-801	Piping & Instrumentation Diagram Freshwater and Sanitary System Utility Water Header - Condensate & Diesel Storage and Sanitary Treatment Area	Rev 0	P&C
USAL-CB-PDPID-80-000976-802	Piping & Instrumentation Diagram Freshwater and Sanitary System Utility Water Header - BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-80-000976-803	Piping & Instrumentation Diagram Freshwater and Sanitary System Utility Water Header - LP Flare Area	Rev 0	P&C
USAL-CB-PDPID-80-000976-804	Piping & Instrumentation Diagram Freshwater and Sanitary System Utility Water Header - LNG Storage Tank Area	Rev 0	P&C
USAL-CB-PDPID-80-000977-801	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Condensate & Diesel Storage and Sanitary Treatment Area	Rev 0	P&C
USAL-CB-PDPID-80-000977-802	Piping & Instrumentation Diagram Potable Water System Potable Water Header - BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-80-000977-803	Piping & Instrumentation Diagram Potable Water System Potable Water Header - LP Flare Area	Rev 0	P&C
USAL-CB-PDPID-80-000977-804	Piping & Instrumentation Diagram Potable Water System Potable Water Header - LNG Storage Tank Area	Rev 0	P&C
USAL-CB-PDPID-80-000998-801	Piping & Instrumentation Diagram Onshore Drainage and Discharge System Impoundment Sumps and Pumps - LNG Storage Tank Area and BOG Compressor Area	Rev 0	P&C
USAL-CB-PDPID-90-000691-901	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Loading Arm FAY691871 - Berth 1	Rev 0	P&C
USAL-CB-PDPID-90-000691-902	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Loading Arm FAY691872 - Berth 1	Rev 0	P&C
USAL-CB-PDPID-90-000691-903	Piping & Instrumentation Diagram LNG Storage and Loading System Vapor Return Arm FAY691873 - Berth 1	Rev 0	P&C



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDPID-90-000691-904	Piping & Instrumentation Diagram LNG Storage and Loading System LNG Loading/Vapor Hybrid Arm FAY691874 - Berth 1	Rev 0	P&C
USAL-CB-PDPID-90-000691-905	Piping & Instrumentation Diagram LNG Storage and Loading System Loading Arm Drain/Surge Drum - Berth 1	Rev 0	P&C
USAL-CB-PDPID-90-000951-901	Piping & Instrumentation Diagram Utility/Service Air Distribution System Offshore Trestle Area	Rev 0	P&C
USAL-CB-PDPID-90-000952-901	Piping & Instrumentation Diagram Instrument Air Distribution System Offshore Trestle Area	Rev 0	P&C
USAL-CB-PDPID-90-000961-901	Piping & Instrumentation Diagram Nitrogen System Nitrogen Header - Offshore Trestle Area	Rev 0	P&C
USAL-CB-PDPID-90-000976-901	Piping & Instrumentation Diagram Freshwater and Sanitary System Utility Water Header - Offshore Trestle Area	Rev 0	P&C
USAL-CB-PDPID-90-000977-901	Piping & Instrumentation Diagram Potable Water System Potable Water Header - Offshore Trestle Area	Rev 0	P&C
USAL-CB-PDPID-90-000998-901	Piping & Instrumentation Diagram Onshore Drainage and Discharge System Impoundment Sumps and Pumps - Offshore Trestle Area	Rev 0	P&C
USAL-CB-PDSYM-00-000000-001	Piping & Instrumentation Diagram Standard Symbols And Nomenclature General Tagging And Abbreviations (1)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-002	Piping & Instrumentation Diagram Standard Symbols And Nomenclature General Tagging And Abbreviations (2)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-003	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Piping Symbols (1)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-004	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Piping Symbols (2)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-005	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Instrument Tagging And Symbols (1)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-006	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Instrument Tagging And Symbols (2)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-007	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Instrument Tagging And Symbols (3)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-008	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Equipment Symbols (1)	Rev 1	P&C



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USAL-CB-PDSYM-00-000000-009	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Equipment Symbols (2)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-010	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Equipment Symbols (3)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-011	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Equipment Symbols (4)	Rev 1	P&C
USAL-CB-PDSYM-00-000000-012	Piping & Instrumentation Diagram Standard Symbols And Nomenclature Equipment Symbols (5)	Rev 1	P&C

E.6 – Plant and Equipment Layouts

Document Number:	Description:	Revision:	Appendix:
USAL-CB-LDLAY-00-000003-000	LNG Liquefaction Facility Overall Complex Site Plan	Rev 6	Public
USAL-CB-LDLAY-00-000001-000	Plot Plan – Offshore Trestle Area	Rev 2	CEII
USAL-CB-LDLAY-00-000007-000	Plot Plan – Inlet Gas Treating and HP & LP Fuel Area	Rev 3	CEII
USAL-CB-LDLAY-00-000007-001	Plot Plan – Power Generation Area	Rev 1	CEII
USAL-CB-LDLAY-00-000008-000	Plot Plan – Non-Hydrocarbon Utility Area	Rev 3	CEII
USAL-CB-LDLAY-00-000008-001	Plot Plan – Common Process and Utility Area	Rev 1	CEII
USAL-CB-LDLAY-00-000008-002	Plot Plan – Condensate & Diesel Storage and Waste Water Treatment Area	Rev 1	CEII
USAL-CB-LDLAY-00-000009-000	Plot Plan – Admin Area	Rev 3	CEII
USAL-CB-LDLAY-00-000010-000	Plot Plan – Open Ground Flare Area	Rev 3	CEII
USAL-CB-LDLAY-00-000011-000	LNG Liquefaction Facility Area Plot Plan Drawing Index	Rev 3	CEII
USAL-CB-LDLAY-00-000012-000	Plot Plan – LNG Storage Area	Rev 3	CEII
USAL-CB-CDTOP-00-000057-001	Civil Site Topographical Plan Layout	Rev 1	Public

E.7 – Plant Reliability, Availability, and Maintainability (RAM) Analyses*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public



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E.8 - Piperack Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-NDCPT-00-000274-001	Structural Steel Overall Piperacks Key Plan Layout	Rev 0	CEII
USAL-CB-NDCPT-00-000274-002	Structural Steel Main Unit Piperack Transverse Elevation Section A	Rev 0	CEII
USAL-CB-NDCPT-00-000274-003	Structural Steel Main Unit Piperack Longitudinal Elevation Section B	Rev 0	CEII
USAL-CB-NDCPT-00-000274-004	Structural Steel Piperack Typical Bents Section C through J	Rev 0	CEII
USAL-CB-NDCPT-00-000274-005	Structural Steel Piperack Longitudinal Elevation Section K and L	Rev 0	CEII
USAL-CB-NDCPT-00-000274-006	Structural Steel Piperack Longitudinal Elevation Section M through P	Rev 0	CEII

E.9 - Rough Grading Plan Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-CDDET-00-000088-001	Civil Rough Grading Key Plan Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-002	Civil Rough Grading Plan Area 1 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-003	Civil Rough Grading Plan Area 2 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-004	Civil Rough Grading Plan Area 3 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-005	Civil Rough Grading Plan Area 4 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-006	Civil Rough Grading Plan Area 5 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-007	Civil Rough Grading Plan Area 6 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-008	Civil Rough Grading Plan Area 7 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-009	Civil Rough Grading Plan Area 8 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-010	Civil Rough Grading Plan Area 9 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-011	Civil Rough Grading Plan Area 10 Layout	Rev 2	CEII
USAL-CB-CDDET-00-000088-012	Civil Rough Grading Plan Area 11 Layout	Rev 1	CEII
USAL-CB-CDDET-00-000088-013	Civil Rough Grading Plan Area 12 Layout	Rev 1	CEII
USAL-CB-CDDET-00-000088-014	Civil Rough Grading Plan Area 13 Layout	Rev 1	CEII
USAL-CB-CDDET-00-000088-015	Civil Rough Grading Plan Area 14 Layout	Rev 2	CEII



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E.10 - Storm Water Drainage Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-CDDRN-00-000998-001	Civil Drainage Key Plan Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-002	Civil Drainage Plan Area 1 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-003	Civil Drainage Plan Area 2 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-004	Civil Drainage Plan Area 3 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-005	Civil Drainage Plan Area 4 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-006	Civil Drainage Plan Area 5 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-007	Civil Drainage Plan Area 6 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-008	Civil Drainage Plan Area 7 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-009	Civil Drainage Plan Area 8 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-010	Civil Drainage Plan Area 9 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-011	Civil Drainage Plan Area 10 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-012	Civil Drainage Plan Area 11 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-013	Civil Drainage Plan Area 12 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000998-014	Civil Drainage Plan Area 13 Layout	Rev 2	CEII
USAL-CB-CDDRN-00-000998-015	Civil Drainage Plan Area 14 Layout	Rev 1	CEII

E.11 - Essential Lighting Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-EDLGT-00-000001-000	Electrical Essential Lighting Layout Key Plan	Rev 2	Public
USAL-CB-EDLGT-00-000001-001	Electrical Essential Lighting Layout Control Building and Office Area Plan	Rev 2	Public
USAL-CB-EDLGT-00-000003-001	Electrical Lighting Plot Plan Security and Perimeter Fence	Rev 2	Public
USAL-CB-EDLGT-10-000001-001	Electrical Essential Lighting Layout Liquefaction Train 1 Plan	Rev 2	Public
USAL-CB-EDLGT-20-000001-001	Electrical Essential Lighting Layout Liquefaction Train 2 Plan	Rev 2	Public
USAL-CB-EDLGT-30-000001-001	Electrical Essential Lighting Layout Liquefaction Train 3 Plan	Rev 2	Public

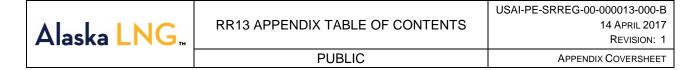


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Document Number:	Description:	Revision:	Appendix:
USAL-CB-EDLGT-50-000003-001	Electrical Essential Lighting Layout Inlet Gas Treatment and HP & LP Fuel Area Plan	Rev 2	Public
USAL-CB-EDLGT-60-000001-001	Electrical Essential Lighting Layout Power Generation Area Plan	Rev 2	Public
USAL-CB-EDLGT-60-000002-001	Electrical Essential Lighting Layout Non- Hydrocarbon Utility Area Plan	Rev 2	Public
USAL-CB-EDLGT-60-000004-001	Electrical Essential Lighting Layout Waste Water Treatment Area Plan	Rev 2	Public
USAL-CB-EDLGT-70-000002-001	Electrical Essential Lighting Layout Condensate Loading Area Plan	Rev 2	Public
USAL-CB-EDLGT-70-000003-001	Electrical Essential Lighting Layout North Gate and Main Gate Area Plan	Rev 2	Public
USAL-CB-EDLGT-70-000004-001	Electrical Essential Lighting Layout Open Ground Flare Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000001-001	Electrical Essential Lighting Layout Common Process and Utility Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000002-001	Electrical Essential Lighting Layout LNG Storage Tank Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000003-001	Electrical Essential Lighting Layout LNG Storage Tank Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000004-001	Electrical Essential Lighting Layout Trestle Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000005-001	Electrical Essential Lighting Layout Trestle Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000006-001	Electrical Essential Lighting Layout Berth 1 Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000007-001	Electrical Essential Lighting Layout Berth 2 Area Plan	Rev 2	Public

E.12 - Security Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-CDFEN-00-000087-001	Civil Site Security Fence Plan Layout	Rev 2	P&C
USAL-CB-CDFEN-00-000087-101	Civil Site Security Fence Sections and Details Layout	Rev 1	P&C
USAL-CB-IDLAY-00-000735-001	Instrumentation CCTV and Site Security Fence Equipment Location Plan Layout	Rev 1	P&C



APPENDIX 13F - SPECIFICATIONS

F.1 – Civil Specifications

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-CCC-LIS-DOC-00003	Civil Specification List	0	P&C
USAL-CB-CSPDS-00-000002-000	Specification for Site Preparation and Earthwork	Rev 0	P&C
USAL-CB-NSPDS-00-000002-000	Specification for Structural Steel	Rev 2	P&C
USAL-CB-NSPDS-00-000001-000	Specification for Structural Concrete	Rev 2	P&C
USAL-CB-CSPDS-00-000001-000	Specification for Buildings	Rev 1	P&C

F.2 – Mechanical Specifications

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-MMM-LIS-DOC-00003	Mechanical Specification List	0	P&C
USAL-CB-LSPDS-00-000001-000	Piping Material Classifications Line Class 150	Rev 1	P&C
USAL-CB-LSPDS-00-000002-000	Piping Material Classifications Line Class 300	Rev 1	P&C
USAL-CB-LSPDS-00-000003-000	Piping Material Classifications Line Class 600	Rev 1	P&C
USAL-CB-LSPDS-00-000004-000	Piping Material Classifications Line Class 900	Rev 1	P&C
USAL-CB-LSPDS-00-000005-000	Piping Material Classifications Line Class 1500	Rev 0	P&C
USAL-CB-LSPDS-00-000006-000	Piping Material Classifications Line Class 2500	Rev 1	P&C
USAL-CB-RSPDS-00-015665-000	Specification for Sound Control Insulation for Piping, Valves and Flanges	Rev 0	P&C
USAL-CB-RSPDS-00-290220-000	Specification For Hot Insulation	Rev 0	P&C
USAL-CB-RSPDS-00-290221-000	Specification For Cold Insulation	Rev 0	P&C

F.3 – Electrical and Instrumentation Specifications

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-EEE-LIS-DOC-00007	Electrical and Instrumentation Specification List	0	P&C
USAI-PT-ISPDS-00-150707-000	Safety Instrument System Specification	Rev 0	P&C



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F.4 - Security and Fire Safety Specifications

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-HSE-LIS-DOC-00002	Security and Fire Specification List	0	P&C

APPENDIX 13G – HAZARD IDENTIFICATION

G.1 – Process Hazard Analyses and Recommendations

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FRHAZ-00-000001-000	Pre-FEED HAZID Workshop Report, July 28 thru 31, 2015	Rev 0	P&C
USAL-CH-FRHAZ-90-000001-001	Hazard Identification (HAZID) Workshop Report – PLF and SVF Construction	Rev 1	P&C
USAL-CH-FRHAZ-90-000002-001	Hazard Identification (HAZID) Workshop Report – MOF Construction and Operations	Rev 1	P&C

G.2 – Simultaneous Operations Studies

Document Number:	Description:	Revision:	Appendix:
N/A	N/A	N/A	Public

G.3 - Waterway Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

G.4 – Road Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

G.5 - Rail Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

G.6 – Air Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



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G.7 - Crane and Lifting Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

G.8 – Security Threat and Vulnerability Analyses

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

APPENDIX 13H - HAZARD ANALYSES

H.1 – Safety Data Sheets

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-HSE-RTA-DOC-00006	Safety Data Sheets	0	Public

H.2 - Hazardous Release List

Document Number:	Description:	Revision:	Appendix:
N/A	Hazardous Release List is included in the Hazard Analysis Report in Appendix H.3	N/A	Public

H.3 - Hazard Analysis Reports

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-HSE-RTA-DOC-00004	Hazard Analysis Report	0	Public

H.4 - Meteorological Data

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-HSE-RTA-DOC-00005	Meteorological Data Report	0	Public

APPENDIX 13I – NATURAL HAZARD DESIGN INVESTIGATIONS AND FORCES

I.1 - Seismic Hazard Evaluation

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRHAZ-00-002015-001	LNG Facilities Probabilistic Seismic Hazard Analysis (PSHA) Report	Rev 0	Public



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I.2 - Seismic Engineering Report

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRHAZ-00-002016-008	LNG Facilities Seismic Engineering Report	Rev 0	Public

1.3 - Seismic Categorization List

Document Number:	Description:	Revision:	Appendix:
USAL-CB-MLMEL-00-000001-000	Seismic Categorization List (this information is found in the Master Equipment List)	Rev 0	Public

APPENDIX 13J – SITE INVESTIGATION AND CONDITIONS, AND FOUNDATION DESIGN

J.1 - Geotechnical Hazard Report

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRHAZ-00-002015-002	LNG Facilities Geologic Hazard Report	Rev 0	Public

J.2 - Geotechnical Data Report

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRZZZ-00-002016-001	LNG Facilities Onshore Geotechnical Data Report	Rev 0	Public

J.3 - Onshore Geophysical Survey Report

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRZZZ-00-002015-005	LNG Facilities Onshore Geophysical Survey Report	Rev 0	Public

J.4 - Marine Geophysical Survey Report

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRZZZ-00-002015-010	LNG Facilities Marine Geophysical Survey Report	Rev 0	Public

J.5 - Marine Geotechnical Report

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRZZZ-00-002015-011	LNG Facilities Marine Geotechnical Data Report	Rev 0	Public



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J.6 - Hydrogeologic Report

Document Number:	Description:	Revision:	Appendix:
USAL-GL-GRZZZ-00-002016-007	LNG Facilities Onshore Hydrogeologic Report	Rev 0	Public

J.7 - LNG Facilities Onshore Integrated Site Characterization and Geotechnical Engineering Report

Document Number:	Description:	Revision:	Appendix:
USAL-FG-GRZZZ-00-002016-009	LNG Facilities Onshore Integrated Site Characterization And Geotechnical	Rev 0	Public
	Engineering Report		

J.8 - Foundation Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-NDCPT-00-000277-001	Common Concrete Foundation Typical Piperack Plans & Sections	Rev 0	CEII
USAL-CB-NDCPT-00-000277-002	Common Concrete Foundation Typical Vertical Vessel Plans & Section	Rev 0	CEII
USAL-CB-NDCPT-00-000277-003	Common Concrete Foundation Typical Compressor Table Top Plan & Sections	Rev 0	CEII
USAL-CB-NDCPT-00-000277-004	Common Concrete Foundation Typical Horizontal Vessel Plan, Sections & Details	Rev 0	CEII

J.9 – Bathymetry Map

Document Number:	Description:	Revision:	Appendix:
N/A	Bathymetry Map Marine LNE Terminal and ASRC Dock Area	Rev 0	Public

APPENDIX 13K - MARINE SYSTEMS

K.1 – Marine Facility Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-LDLAY-00-000001-000	Plot Plan - Offshore Trestle Area	Rev 2	CEII
USAL-CB-LDLAY-00-000001-001	Berth 1 Loading Dock Layout	Rev 0	CEII
USAL-CB-LDLAY-00-000001-003	Section "A-A" Berth 1 Loading Dock	Rev 0	CEII
USAL-CB-LDLAY-00-000001-004	Section "B-B" Berth 2 Loading Dock	Rev 0	CEII
USAL-CB-LDLAY-00-000001-005	Sections "C-C" and "D-D" Trestle Cross Sections at Intersection	Rev 0	CEII
USAL-CB-LDLAY-00-000001-006	Plan of Loops	Rev 0	CEII



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-LDLAY-00-000001-007	Section "E-E" And "F-F" Elevations of Trestle	Rev 0	CEII
USAL-CB-LDLAY-00-000001-008	Section "G-G" Trestle At Bluff	Rev 0	CEII
USAL-CB-LDLAY-00-000001-009	Marine Terminal Dock Layout & Elevation	Rev 0	CEII
USAL-CB-LDLAY-00-000001-010	Upper & Lower Piping Plans Plans at Trestle Intersection	Rev 0	CEII

APPENDIX 13L - LNG STORAGE TANK INFORMATION

L.1 - Tank Specification

Document Number:	Description:	Revision:	Appendix:
USAL-CB-MSZZZ-80-000001-000	LNG Tank Specification	Rev 1	CEII

L.2 - LNG Tank Drawings

Document Number:	Description:	Revision:	Appendix:
AGDC-13.L.2.1 Sheet Number 01	Arrangement of Outer and Inner Tanks	Rev 1	CEII
AGDC-13.L.2.7 Sheet Number 01	Arrangement of Pipe Support Structure	Rev 1	CEII
AGDC-13.L.2.6 Sheet Number 03	Sectional Elevation of 240,000m³ Tank	Rev 1	CEII
AGDC-13.L.2.8 Sheet Number 04	Arrangement of Roof Spillage Collection Area	Rev 1	CEII
AGDC:13.L.2.15 Sheet Number 05	Inclinometer General Arrangement	Rev 1	CEII
AGDC:13.L.2.14 Sheet Number 06	Arrangement of Base Heating	Rev 1	CEII
AGDC:13.L.2.17 Sheet Number 07	Typical Tank Level Gauge/LTD	Rev 1	CEII
AGDC:13.L.2.8 Sheet Number 08	Thermal Couples Locations – I	Rev 1	CEII
AGDC:13.L.2.13 Sheet Number 09	Thermal Couples Locations – II	Rev 1	CEII
AGDC:13.L.2.6 Sheet Number 10	Piping Penetrations and Schedule of Openings	Rev 1	CEII
AGDC:13.L.2.12 Sheet Number 11	Arrangement of Pressure and Vacuum Relief Assembly	Rev 1	CEII
AGDC:13.L.2.10 Sheet Number 12	Details of Bottom Fill Pipe	Rev 1	CEII
AGDC:13.L.2.10 Sheet Number 13	Details of Top Fill Nozzle	Rev 1	CEII
AGDC:13.L.2.4 Sheet Number 14	Top Corner Insulation Details	Rev 1	CEII
AGDC:13.L.2.4 Sheet Number 15	Bottom Corner Insulation Details	Rev 1	CEII
AGDC:13.L.2.11 Sheet Number 16	Pump Column Arrangement	Rev 1	CEII
AGDC Sheet Number 17	General Arrangement of Roof Platforms - I	Rev 1	CEII
AGDC Sheet Number 17A	General Arrangement of Roof Platforms - II	Rev 1	CEII



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AGDC Sheet Number 18	General Notes	Rev 1	CEII
AGDC Sheet Number 19	Construction Site Plan	Rev 1	CEII
AGDC Sheet Number 20	Elevation: 240,000 m ³ Tank	Rev 1	CEII
AGDC:13.L.2.2 Sheet Number 21	Seismic Isolator Layout	Rev 1	CEII
AGDC Sheet Number 22	Access Tunnel	Rev 1	CEII
AGDC Sheet Number 23	Wall Base Detail	Rev 1	CEII
AGDC Sheet Number 24	Wall Vertical Post-Tensioning	Rev 1	CEII
AGDC Sheet Number 25	Wall Base Support and Seismic Connection	Rev 1	CEII
AGDC Sheet Number 26	Primary Containment Wall Panels	Rev 1	CEII
AGDC Sheet Number 27	Secondary Containment Wall Panels	Rev 1	CEII
AGDC Sheet Number 28	Wall Liner Details	Rev 1	CEII
AGDC Sheet Number 29	Circumferential Prestress and Shotcrete Sections	Rev 1	CEII
AGDC Sheet Number 30	Roof Plan	Rev 1	CEII

L.3 – LNG Tank and Foundation Structural Design

Document Number:	Description:	Revision:	Appendix:
Preload/BergerABAM, A17.0218.00	Conceptual Tank Design Calculation Report	N/A	CEII

APPENDIX 13M - EQUIPMENT INFORMATION

M.1 – Piping and Valve List*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

M.2 - Tie-In List*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

M.3 - Equipment List

Document Number:	Description:	Revision:	Appendix:
USAL-CB-MLMEL-00-000001-000-A	Master Equipment List – Redacted	Rev 0	P&C
USAL-CB-ELMEL-00-000001-000	Electrical Equipment List	Rev 1	CEII



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M.4 – Data Sheets

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FTTDS-60-BAP412602	Data Sheet - Firewater Tank Heater BAP412602A/B	Rev 0	CEII
USAL-CB-FTTDS-60-BBJ412601	Data Sheet - Firewater Tank BBJ412601	Rev 0	CEII
USAL-CB-FTTDS-60-PFW411601	Data Sheet - Firewater Pump (Electric) PFW411601	Rev 0	CEII
USAL-CB-FTTDS-60-PFW411602	Data Sheet - Firewater Pump (Diesel) PFW411602	Rev 0	CEII
USAL-CB-FTTDS-60-PFW411603	Data Sheet - Firewater Jockey Pump PFW411603A/B	Rev 1	CEII
USAL-CB-PTTDS-10-NAP661113	Data Sheet - Defrost Gas Heater NAP661113	Rev 0	CEII
USAL-CB-PTTDS-50-CAR966505	Data Sheet - BOG Recycle Compressor CAR966505	Rev 0	CEII
USAL-CB-PTTDS-50-HBC631502	Data Sheet - Deethanizer Reboiler HBC631502	Rev 0	CEII
USAL-CB-PTTDS-50-HBC631507	Data Sheet - Depropanizer Reboiler HBC631507	Rev 0	CEII
USAL-CB-PTTDS-50-HBC631513	Data Sheet - Debutanizer Reboiler HBC631513	Rev 0	CEII
USAL-CB-PTTDS-50-HBG623501	Data Sheet - Inlet Gas Heater HBG623501	Rev 0	CEII
USAL-CB-PTTDS-50-HBG631503	Data Sheet - Deethanizer Condenser HBG631503	Rev 0	P&C
USAL-CB-PTTDS-50-HBG631519	Data Sheet - LPG Reinjection Cooler HBG631519	Rev 0	P&C
USAL-CB-PTTDS-50-HBG966515	Data Sheet - HP Fuel Gas Heater HBG966515	Rev 0	CEII
USAL-CB-PTTDS-50-HFF631508	Data Sheet - Depropanizer Condenser HFF631508	Rev 0	P&C
USAL-CB-PTTDS-50-HFF631514	Data Sheet - Debutanizer Condenser HFF631514	Rev 0	P&C
USAL-CB-PTTDS-50-HFF631518	Data Sheet - Debutanizer Condensate Product Cooler HFF631518	Rev 0	P&C
USAL-CB-PTTDS-50-HFF661509	Data Sheet - Regeneration Gas Cooler HFF661509	Rev 0	CEII
USAL-CB-PTTDS-50-HFF966506	Data Sheet - BOG Recycle Compressor Aftercooler HFF966506	Rev 0	CEII
USAL-CB-PTTDS-50-MAF631501	Data Sheet - Deethanizer Column MAF631501	Rev 0	P&C
USAL-CB-PTTDS-50-MAF631506	Data Sheet - Depropanizer Column MAF631506	Rev 0	P&C
USAL-CB-PTTDS-50-MAF631512	Data Sheet - Debutanizer Column MAF631512	Rev 0	P&C
USAL-CB-PTTDS-50-MAJ623503	Data Sheet - Inlet Gas Filters MAJ623503A/B/C	Rev 0	CEII



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USAL-CB-PTTDS-50-MAJ661510	Data Sheet - Molecular Sieve Dryer After Filters MAJ661510A/B/C	Rev 0	CEII
USAL-CB-PTTDS-50-MAJ669504	Data Sheet - Mercury Adsorber After Filters MAJ669504A/B/C	Rev 0	CEII
USAL-CB-PTTDS-50-MAJ966501	Data Sheet - Start Up Fuel Gas Filter MAJ966501	Rev 1	CEII
USAL-CB-PTTDS-50-MBA661502	Data Sheet - Molecular Sieve Dryer MBA661502/3/4/5/6/7	Rev 0	CEII
USAL-CB-PTTDS-50-MBA669501	Data Sheet - Mercury Adsorber MBA669501/2/3	Rev 0	CEII
USAL-CB-PTTDS-50-MBD623504	Data Sheet - Inlet Gas Heater Condensate Pot MBD623504	Rev 0	CEII
USAL-CB-PTTDS-50-MBD631504	Data Sheet - Deethanizer Reflux Drum MBD631504	Rev 0	P&C
USAL-CB-PTTDS-50-MBD631509	Data Sheet - Depropanizer Reflux Drum MBD631509	Rev 0	P&C
USAL-CB-PTTDS-50-MBD631515	Data Sheet - Debutanizer Reflux Drum MBD631515	Rev 0	P&C
USAL-CB-PTTDS-50-MBD631520	Data Sheet - LPG Reinjection KO Drum MBD631520	Rev 0	P&C
USAL-CB-PTTDS-50-MBD631522	Data Sheet - Fractionation FEED Separator MBD631522	Rev 0	P&C
USAL-CB-PTTDS-50-MBD631545	Data Sheet - Deethanizer Reboiler Condensate Pot MBD631545	Rev 0	P&C
USAL-CB-PTTDS-50-MBD631546	Data Sheet - Depropanizer Reboiler Condensate Pot MBD631546	Rev 0	P&C
USAL-CB-PTTDS-50-MBD631547	Data Sheet - Debutanizer Reboiler Condensate Pot MBD631547	Rev 0	P&C
USAL-CB-PTTDS-50-MBD661512	Data Sheet - Regeneration Gas KO Drum MBD661512	Rev 0	CEII
USAL-CB-PTTDS-50-MBD966510	Data Sheet - HP Fuel Gas Heater Condensate Pot MBD966510	Rev 0	CEII
USAL-CB-PTTDS-50-MFG965501	Data Sheet - LP Fuel Gas Drum MFG965501	Rev 0	CEII
USAL-CB-PTTDS-50-MFG966503	Data Sheet - HP Fuel Gas Mixing Drum MFG966503	Rev 0	CEII
USAL-CB-PTTDS-50-NAP661513	Data Sheet - Regeneration Gas Heater NAP661513/14	Rev 0	CEII
USAL-CB-PTTDS-50-NAP966502	Data Sheet - Start Up Fuel Gas Heater NAP966502	Rev 0	CEII
USAL-CB-PTTDS-50-NAP966516	Data Sheet - Excess LPG Vaporizer NAP966516	Rev 0	CEII
USAL-CB-PTTDS-50-PBA631505	Data Sheet - Deethanizer Reflux Pumps PBA631505A/B	Rev 0	P&C
USAL-CB-PTTDS-50-PBA631510	Data Sheet - Depropanizer Reflux Pumps PBA631510A/B	Rev 0	P&C



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USAL-CB-PTTDS-50-PBA631511	Data Sheet - Propane Reinjection Pumps PBA631511A/B	Rev 0	P&C
USAL-CB-PTTDS-50-PBA631516	Data Sheet - Debutanizer Reflux Pumps PBA631516A/B	Rev 0	P&C
USAL-CB-PTTDS-50-PBA631517	Data Sheet - Butane Reinjection Pumps PBA631517A/B	Rev 0	P&C
USAL-CB-PTTDS-50-PBA631521	Data Sheet - LPG Reinjection Pumps PBA631521A/B	Rev 0	P&C
USAL-CB-PTTDS-60-ABJ987663	Data Sheet - Steam Condensate Tank ABJ987663	Rev 0	CEII
USAL-CB-PTTDS-60-BBJ976605	Data Sheet - Fresh Water Tank BBJ976605/606	Rev 0	CEII
USAL-CB-PTTDS-60-BBJ976614	Data Sheet - Clarified Water Clearwell Tank BBJ976614	Rev 0	CEII
USAL-CB-PTTDS-60-BBJ976626	Data Sheet - Filtered Water Storage Tank BBJ976626	Rev 0	CEII
USAL-CB-PTTDS-60-BBJ977601	Data Sheet - RO Permeate Tank BBJ977601	Rev 0	CEII
USAL-CB-PTTDS-60-BBJ977621	Data Sheet - Potable Water Storage Tank BBJ977621	Rev 0	CEII
USAL-CB-PTTDS-60-BBJ979620	Data Sheet - Demineralized Water Storage Tank BBJ979620	Rev 0	CEII
USAL-CB-PTTDS-60-HBG976609	Data Sheet - Fresh Water Pre-Heater HBG976609	Rev 0	CEII
USAL-CB-PTTDS-60-HBG987666	Data Sheet - Contaminated Condensate Cooler HBG987666	Rev 0	CEII
USAL-CB-PTTDS-60-HFF948616	Data Sheet - Blowdown Cooler 1 HFF948616	Rev 0	CEII
USAL-CB-PTTDS-60-HFF987618	Data Sheet - LP Steam Dump Condenser 1 HFF987618	Rev 0	CEII
USAL-CB-PTTDS-60-HFF987661	Data Sheet - Steam Condensate Cooler HFF987661	Rev 0	CEII
USAL-CB-PTTDS-60-HFF987668	Data Sheet - LP Steam Condenser HFF987668	Rev 0	CEII
USAL-CB-PTTDS-60-HPL987662	Data Sheet - Demin/Condensate Exchanger HPL987662	Rev 0	CEII
USAL-CB-PTTDS-60-MAJ977632	Data Sheet - Activated Carbon Cartridge Filters MAJ977632A/B	Rev 0	CEII
USAL-CB-PTTDS-60-MAJ987665	Data Sheet - Condensate Activated Carbon Filter MAJ987665A/B/C	Rev 0	CEII
USAL-CB-PTTDS-60-MAM956602	Data Sheet - Compressed Air Receiver MAM956602	Rev 0	CEII
USAL-CB-PTTDS-60-MBD976640	Data Sheet - Fresh Water Pre-Heater Condensate Pot MBD976640	Rev 0	CEII
USAL-CB-PTTDS-60-MBD987667	Data Sheet - LP Condensate Separator MBD987667	Rev 0	CEII



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USAL-CB-PTTDS-60-MBE961630	Data Sheet - Nitrogen Receiver MBE961630	Rev 0	CEII
USAL-CB-PTTDS-60-MIA956610	Data Sheet - Instrument Air Receiver MIA956610	Rev 0	CEII
USAL-CB-PTTDS-60-PBA976601	Data Sheet - Well Pumps PBA976601/602/641/642	Rev 1	CEII
USAL-CB-PTTDS-60-PBA976607	Data Sheet - Fresh Water Tank Pumps PBA976607A/B	Rev 1	CEII
USAL-CB-PTTDS-60-PBA976608	Data Sheet - Fire Water Make Up Pumps PBA976608/648	Rev 0	CEII
USAL-CB-PTTDS-60-PBA976628	Data Sheet - Filtered Water Forwarding Pumps PBA976628A/B	Rev 1	CEII
USAL-CB-PTTDS-60-PBA977602	Data Sheet - RO Permeate Forwarding Pumps PBA977602A/B	Rev 0	CEII
USAL-CB-PTTDS-60-PBA977630	Data Sheet - Potable Water Forwarding Pumps PBA977630A/B	Rev 1	CEII
USAL-CB-PTTDS-60-PBA979632	Data Sheet - Demineralized Water Forwarding Pumps PBA979632A/B	Rev 0	CEII
USAL-CB-PTTDS-60-PBE987664	Data Sheet - Steam Condensate Tank Pumps PBE987664A/B/C	Rev 0	CEII
USAL-CB-PTTDS-60-PBE987669	Data Sheet - LP Condensate Pumps PBE987669A/B	Rev 0	CEII
USAL-CB-PTTDS-60-PBH976616	Data Sheet - Reclaimed Water Sump Pumps PBH976616A/B	Rev 0	CEII
USAL-CB-PTTDS-60-PBH979634	Data Sheet - Chemical Sump Lift Pumps PBH979634A/B	Rev 0	CEII
USAL-CB-PTTDS-60-PBM976617	Data Sheet - Clarified Water Forwarding Pumps PBM976617A/B	Rev 2	CEII
USAL-CB-PTTDS-60-PBM977612	Data Sheet - Sodium Hypochlorite Distribution Pumps PBM977612A/B	Rev 0	CEII
USAL-CB-PTTDS-60-V955601	Data Sheet - Air Compressor Package V955601	Rev 0	CEII
USAL-CB-PTTDS-60-V956603	Data Sheet - Instrument Air Dryer Package V956603	Rev 0	CEII
USAL-CB-PTTDS-60-V961601	Data Sheet - Purge Nitrogen Generation Packages V961601A/B	Rev 0	CEII
USAL-CB-PTTDS-60-V961602	Data Sheet - High Purity Cryogenic Nitrogen Generation Package V961602	Rev 0	CEII
USAL-CB-PTTDS-60-V961640	Data Sheet - High Purity Liquid Nitrogen Storage & Vaporizer Package V961640	Rev 0	CEII
USAL-CB-PTTDS-60-V976610	Data Sheet - Clarification and Filter Press Package V976610	Rev 0	CEII
USAL-CB-PTTDS-60-V976621	Data Sheet - Water Purification Packages V976621/631/638/979601	Rev 0	CEII
USAL-CB-PTTDS-60-V977604	Data Sheet - Potable Water Package V977604	Rev 0	CEII



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USAL-CB-PTTDS-60-V977611	Data Sheet - Sodium Hypochlorite Generator Package V977611	Rev 0	CEII
USAL-CB-PTTDS-60-V979640	Data Sheet - Neutralization Package V979640	Rev 0	CEII
USAL-CB-PTTDS-70-ABJ634701	Data Sheet - Condensate Storage Tank ABJ634701	Rev 0	CEII
USAL-CB-PTTDS-70-ABJ634704	Data Sheet - Offspec Condensate Storage Tank ABJ634704	Rev 0	CEII
USAL-CB-PTTDS-70-BBJ911701	Data Sheet - Diesel Storage Tank BBJ911701	Rev 1	CEII
USAL-CB-PTTDS-70-BBJ997720	Data Sheet - Equalization Tank BBJ997720	Rev 0	CEII
USAL-CB-PTTDS-70-EAL634706	Data Sheet - Thermal Oxidizer EAL634706	Rev 0	CEII
USAL-CB-PTTDS-70-FLRH612703	Data Sheet - Wet and Dry Ground Flare FLRH612703A/B/C	Rev 0	CEII
USAL-CB-PTTDS-70-MAJ911704	Data Sheet - Diesel Fuel Filter MAJ911704	Rev 0	CEII
USAL-CB-PTTDS-70-MAJ911705	Data Sheet - Diesel Truck Unloading Filter MAJ911705	Rev 0	CEII
USAL-CB-PTTDS-70-MBD612701	Data Sheet - Dry Flare KO Drum MBD612701	Rev 0	CEII
USAL-CB-PTTDS-70-MBD612705	Data Sheet - Wet Flare KO Drum MBD612705	Rev 0	CEII
USAL-CB-PTTDS-70-MBD612708	Data Sheet - Dry Flare Blowcase MBD612708	Rev 0	CEII
USAL-CB-PTTDS-70-MBJ698701	Data Sheet - Ethane Refrigerant Storage Bullets MBJ698701/2	Rev 0	CEII
USAL-CB-PTTDS-70-MBJ698721	Data Sheet - Propane Refrigerant Storage Bullets MBJ698721/2/3/4	Rev 0	CEII
USAL-CB-PTTDS-70-MBJ964750	Data Sheet - Slop Oil Tank MBJ964750	Rev 0	CEII
USAL-CB-PTTDS-70-NAP612709	Data Sheet - Scrub Column Bottoms Vaporizer NAP612709	Rev 1	CEII
USAL-CB-PTTDS-70-NAP698711	Data Sheet - Ethane Vaporizers NAP698711/12	Rev 0	CEII
USAL-CB-PTTDS-70-PBA634702	Data Sheet - Condensate Loading Pumps PBA634702A/B	Rev 0	CEII
USAL-CB-PTTDS-70-PBA634705	Data Sheet - Offspec Condensate Pump PBA634705A/B	Rev 0	CEII
USAL-CB-PTTDS-70-PBA698713	Data Sheet - Propane Unloading Pump PBA698713	Rev 0	CEII
USAL-CB-PTTDS-70-PBA698718	Data Sheet - Propane Storage Pump PBA698718	Rev 0	CEII
USAL-CB-PTTDS-70-PBA911702	Data Sheet - Diesel Transfer Pumps PBA911702A/B	Rev 0	CEII



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USAL-CB-PTTDS-70-PBA964734	Data Sheet - CPI Slop Oil Pumps PBA964734A/B	Rev 0	CEII
USAL-CB-PTTDS-70-PBA964736	Data Sheet - CPI Sludge Pumps PBA964736A/B	Rev 0	CEII
USAL-CB-PTTDS-70-PBA997722	Data Sheet - Equalization Tank Pumps PBA997722A/B	Rev 0	CEII
USAL-CB-PTTDS-70-PBA997769	Data Sheet - Flotation Unit Sludge Pumps PBA997769A/B	Rev 1	CEII
USAL-CB-PTTDS-70-PBD997721	Data Sheet - Equalization Tank Skimmer PBD997721	Rev 0	CEII
USAL-CB-PTTDS-70-PBE612706	Data Sheet - Wet Flare KO Drum Pump PBE612706A/B	Rev 0	CEII
USAL-CB-PTTDS-70-PBE964751	Data Sheet - Slop Oil Transfer Pump PBE964751	Rev 0	CEII
USAL-CB-PTTDS-70-PBH991111	Data Sheet - Oil Sump Pumps PBH991111/611/612 A/B	Rev 0	CEII
USAL-CB-PTTDS-70-PBH997121	Data Sheet - PCSW Collection Sump 1 Pump PBH997111/121/112/122/511/521/611/ 621/612/622/613/623/614/624	Rev 2	CEII
USAL-CB-PTTDS-70-PBH997523	Data Sheet - PCSW Collection Sump 3 Pump PBH997513/23	Rev 2	CEII
USAL-CB-PTTDS-70-PBH997764	Data Sheet - Observation Basin Pumps PBH997764/65	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998112	Data Sheet - Liquefaction Compressor Impoundment Sump Pumps PBH998112/22/13/23	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998121	Data Sheet - Liquefaction Train Impoundment Sump Pumps PBH998111/21	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998512	Data Sheet - Fractionation Area Impoundment Sump Pumps PBH998512/22	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998721	Data Sheet - Condensate Truck Loading Area Impoundment Sump Pumps PBH998721/711	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998722	Data Sheet - Refrigerant Storage Area Impoundment Sump Pumps PBH998712/22	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998813	Data Sheet - LNG Storage Tank Area Impoundment Sump Pumps PBH998813/23	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998814	Data Sheet - BOG Compressor Area Impoundment Sump Pumps PBH998814/24	Rev 0	CEII
USAL-CB-PTTDS-70-PBH998821	Data Sheet - LNG Loading Berth 1/2 Impoundment Sump Pumps PBH998811/21/12/22	Rev 0	CEII



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USAL-CB-PTTDS-70-V997731	Data Sheet - CPI Separator Package V997731	Rev 0	CEII
USAL-CB-PTTDS-70-V997740	Data Sheet - DGF Package V997740	Rev 0	CEII
USAL-CB-PTTDS-80-ABJ691810	Data Sheet - LNG Storage Tank ABJ691810/20	Rev 1	CEII
USAL-CB-PTTDS-80-CAE691841	Data Sheet - LP/HP BOG Compressors CAE691841/42/51/52/61/62	Rev 0	CEII
USAL-CB-PTTDS-80-FAY691871	Data Sheet - LNG Loading/Vapor Return Arms Berth 1/2 FAY691871/72/73/74/81/82/83/84	Rev 1	CEII
USAL-CB-PTTDS-80-FLRL613800	Data Sheet - LP Flare FLRL613800	Rev 0	CEII
USAL-CB-PTTDS-80-HFF691843	Data Sheet - BOG Compressor Aftercoolers HFF691843/53/63	Rev 0	CEII
USAL-CB-PTTDS-80-JAR691816	Data Sheet - BOG Compressor Suction Drum Desuperheaters JAR691816/26/36	Rev 1	CEII
USAL-CB-PTTDS-80-MAB691840	Data Sheet - BOG Compressor Suction Drum Blowcase MAB691840	Rev 0	CEII
USAL-CB-PTTDS-80-MAB691877	Data Sheet - Loading Arm Drain/Surge Drum Blowcase Berth 1/2 MAB691877/87	Rev 1	CEII
USAL-CB-PTTDS-80-MBD613801	Data Sheet - LP Flare KO Drum MBD613801	Rev 0	CEII
USAL-CB-PTTDS-80-MBD691815	Data Sheet - BOG Compressor Suction Drums MBD691815/25/35	Rev 0	CEII
USAL-CB-PTTDS-80-MBD691876	Data Sheet - Loading Arm Drain/Surge Drum Berth 1/2 MBD691876/86	Rev 1	CEII
USAL-CB-PTTDS-80-PBA691811	Data Sheet – LNG Loading & Circulating Pumps	Rev 0	CEII
USAL-CB-PTTDS-10-CAE666112	Data Sheet - Propane Refrigerant Compressor CAE666112/52	Rev 0	P&C
USAL-CB-PTTDS-10-CAE666113	Data Sheet - LP MR Compressor CAE666113/53	Rev 0	P&C
USAL-CB-PTTDS-10-CAE666114	Data Sheet - MP/HP MR Compressor CAE666114/54	Rev 0	P&C
USAL-CB-PTTDS-10-HBG666103	Data Sheet - MR/LP Propane Cooler HBG666103	Rev 0	P&C
USAL-CB-PTTDS-10-HBG666104	Data Sheet - MR/MP Propane Cooler HBG666104	Rev 0	P&C
USAL-CB-PTTDS-10-HBG666105	Data Sheet - MR/HP Propane Cooler HBG666105	Rev 0	P&C
USAL-CB-PTTDS-10-HBG666197	Data Sheet - Propane Reclaimer Condenser HBG666197	Rev 0	P&C
USAL-CB-PTTDS-10-HBG695101	Data Sheet - Feed Gas/MP Propane Cooler HBG695101	Rev 0	P&C
USAL-CB-PTTDS-10-HBG695102	Data Sheet - Feed Gas/LP Propane Cooler HBG695102	Rev 0	P&C



Document Number:

USAL-CB-PTTDS-10-MAF695104

USAL-CB-PTTDS-10-MBA666192

USAL-CB-PTTDS-10-MBA666194

USAL-CB-PTTDS-10-MBA666196

USAL-CB-PTTDS-10-MBD666101

USAL-CB-PTTDS-10-MBD666106

USAL-CB-PTTDS-10-MBD666123

USAL-CB-PTTDS-10-MBD666124

USAL-CB-PTTDS-10-MBD666141

USAL-CB-PTTDS-10-MBD666142

USAL-CB-PTTDS-10-MBD666143

USAL-CB-PTTDS-10-MBD695107

USAL-CB-PTTDS-10-NAP695105

USAL-CB-PTTDS-10-PBA666195

USAL-CB-PTTDS-10-PBA695106

USAL-CB-PTTDS-10-TGT666102

USAL-CB-PTTDS-10-TGT695109

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MBA666194

MBA666196

MBD666101

MBD666141/181

MBD666142/182

MBD666143/183

MBD695107

NAP695105

PBA666195

TGT666102

TGT695109

Pumps

Description:

Data Sheet - Scrub Column MAF695104

Data Sheet - Propane Accumulator

Data Sheet - Propane Transfer Drum

Data Sheet - Propane Reclaimer

Data Sheet - HP MR Separator

Data Sheet - LP MR Compressor

Data Sheet - HP MR Compressor Suction Drum MBD666123/163

Data Sheet - MP MR Compressor

Data Sheet - LP Propane Suction Drum

Data Sheet - MP Propane Suction Drum

Data Sheet - HP Propane Suction Drum

Data Sheet - Scrub Column Reflux Drum

Data Sheet - Scrub Column Reboiler

Data Sheet - Propane Transfer Pump

Data Sheet - Scrub Column Reflux

Data Sheet - MR Hydraulic Turbine

Data Sheet - LNG Hydraulic Turbine

PBA695106A/B

Suction Drum MBD666106/107

Suction Drum MBD666124/164

Revision: Appendix: Rev 0 P&C P&C Rev 0 P&C Rev 0

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M.5 - Manufacturer's Data

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

M.6 - List of Buildings and Structures

Document Number:	Description:	Revision:	Appendix:
USAL-CB-CLBLD-00-000001-000	Buildings Description and List	0	Public



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M.7 – Building Siting Analysis

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FRZZZ-00-000006-000	Facility Siting Study Report (Baker Risk)	1	P&C

M.8 - Building Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-CDAED-00-OFF062102- 001	Architectural Assembly / Training Building Preliminary Plan	Rev 0	CEII
USAL-CB-CDAED-00-OFF062102- 002	Architectural Assembly/Training Building Preliminary Elevation A & B	Rev 0	CEII
USAL-CB-CDAED-00-OFF062102- 003	Architectural Assembly/Training Building Preliminary Elevation C & D	Rev 0	CEII
USAL-CB-CDAED-00-WHSE064101- 001	Architectural Warehouse Building Preliminary Plan	Rev 0	CEII
USAL-CB-IDLAY-00-000714-001	Analyzer House Typical Layout	Rev 0	CEII
USAL-CB-NDCPT-00-000063-002	Structural Typical Compressor Shelter Preliminary Roof Plan	Rev 0	CEII
USAL-CB-NDCPT-00-000063-003	Structural Typical Compressor Shelter Preliminary Plan @ Crane Rail Beam	Rev 0	CEII
USAL-CB-NDCPT-00-000063-004	Structural Typical Compressor Shelter Preliminary Plan @ Operating Platform	Rev 0	CEII
USAL-CB-NDCPT-00-000063-005	Structural Typical Compressor Shelter Preliminary Elevation @ Col. Line A & B	Rev 0	CEII
USAL-CB-NDCPT-00-000063-006	Structural Typical Compressor Shelter Preliminary Elevation @ Col. Line 1 thru 7	Rev 0	CEII

APPENDIX 13N - ELECTRICAL DESIGN INFORMATION

N.1 - Electrical Load List

Document Number:	Description:	Revision:	Appendix:	
USAL-CB-ELLSC-00-000001-000	Electrical Load List and Summary	Rev 1	Public	

N.2 - Transformer List

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



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N.3 - One Line Diagrams

Document Number:	Description:	Revision:	Appendix:
USAL-CB-EDSLD-00-000001-000	Electrical Overall Electrical One Line Diagram	Rev 3	P&C

N.4 - Overall Power Distribution Block Diagram

Document Number:	Description:	Revision:	Appendix:
USAL-CB-EDBLK-00-000001-000	Electrical Overall Power Distribution Block Diagram	Rev 2	CEII

N.5 - Electrical Area Classification Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-EDHAC-00-000001-000	Electrical Hazardous Area Classification Key Plan	Rev 2	CEII
USAL-CB-EDHAC-00-000001-001	Electrical Hazardous Area Classification LNG Complex Admin Area Plan	Rev 2	CEII
USAL-CB-EDHAC-10-000001-001	Electrical Hazardous Area Classification Liquefaction Train 1 Plan	Rev 2	CEII
USAL-CB-EDHAC-20-000001-001	Electrical Hazardous Area Classification Liquefaction Train 2 Plan	Rev 2	CEII
USAL-CB-EDHAC-30-000001-001	Electrical Hazardous Area Classification Liquefaction Train 3 Plan	Rev 2	CEII
USAL-CB-EDHAC-50-000003-001	Electrical Hazardous Area Classification Inlet Gas Treatment and HP & LP Fuel Area Plan	Rev 2	CEII
USAL-CB-EDHAC-60-000001-001	Electrical Hazardous Area Classification Power Generation Area Plan	Rev 3	CEII
USAL-CB-EDHAC-60-000002-001	Electrical Hazardous Area Classification Non-Hydrocarbon Utility Plan	Rev 2	CEII
USAL-CB-EDHAC-60-000004-001	Electrical Hazardous Area Classification Waste Water Treatment Area Plan 1	Rev 3	CEII
USAL-CB-EDHAC-70-000001-001	Electrical Hazardous Area Classification Open Ground Flare Area Plan	Rev 2	CEII
USAL-CB-EDHAC-70-000002-001	Electrical Hazardous Area Classification Waste Water Treatment Area Plan 2	Rev 2	CEII
USAL-CB-EDHAC-80-000001-001	Electrical Hazardous Area Classification Common Process & Utility Area Plan	Rev 2	CEII
USAL-CB-EDHAC-80-000002-001	Electrical Hazardous Area Classification LNG Storage Tank Area Plan 1	Rev 2	CEII
USAL-CB-EDHAC-80-000003-001	Electrical Hazardous Area Classification LNG Storage Tank Area Plan 2	Rev 2	CEII
USAL-CB-EDHAC-80-000006-001	Electrical Hazardous Area Classification Berth Area Plan 1	Rev 2	CEII
USAL-CB-EDHAC-80-000007-001	Electrical Hazardous Area Classification Berth Area Plan 2	Rev 2	CEII



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N.6 - Electrical Seal Drawings

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-EEE-DWG-DOC-00078	Typical Electrical Seal Arrangement	0	CEII

N.7 - Electrical Layout Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-EDLAY-80-LER822872-001	Electrical General Equipment Arrangement Berth #1 Substation Building - LER822872 Building and Room Layout	Rev 0	CEII
USAL-CB-EDLAY-80-LER822873-001	Electrical General Equipment Arrangement Berth #2 Substation Building - LER822873 Building and Room Layout	Rev 0	CEII
USAL-CB-EDLAY-80-LER823870-001	Electrical General Equipment Arrangement BOG Substation Building - LER823870 Building and Room Layout	Rev 1	CEII
USAL-CB-EDLAY-80-LER823871-001	Electrical General Equipment Arrangement Jetty Area Substation - LER823871 Building and Room Layout	Rev 0	CEII

APPENDIX 130 - PLANS AND PROCEDURES

O.1 Management of Change and Reporting Procedures

Document Number:	Description:	Revision:	Appendix:
USAI-PS-BPMOC-00-000004-000	Management of Change and Reporting Procedure	Rev 0	Public

O.2 - QA/QC Plans and Procedures*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

O.3 – Commissioning Plans*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public



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O.4 - Operating Plans and Procedures*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

O.5 - Maintenance Plans and Procedures*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

O.6 - Safety Procedures*

Document Number:	Description:	Revision:	Appendix:
N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public

APPENDIX 13P – PROCESS CONTROL AND INSTRUMENTATION

P.1 – Instrument Lists

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

P.2 - Control System Architecture Drawings

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

APPENDIX 13Q - SAFETY INSTRUMENTED SYSTEMS AND SHUT OFF VALVES

Q.1 - Cause and Effect Matrix

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDZZZ-50-000001-000	Cause & Effect Diagram System 623/669 Inlet Treating / Mercury Removal	Rev 0	CEII



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Document Number:	Description:	Revision:	Appendix:
USAL-CB-PDZZZ-50-000002-000	Cause & Effect Diagram System 661 Gas Dehydration and Regeneration Gas	Rev 0	CEII
USAL-CB-PDZZZ-50-000003-000	Cause & Effect Diagram System 631 LPG Fractionation	Rev 0	CEII
USAL-CB-PDZZZ-50-000004-000	Cause & Effect Diagram System 965/966 Fuel Gas	Rev 0	CEII
USAL-CB-PDZZZ-60-000001-000	Cause & Effect Diagram System 833/837/984 Power Generation	Rev 0	CEII
USAL-CB-PDZZZ-60-000002-000	Cause & Effect Diagram System 956/961 Air / Nitrogen	Rev 0	CEII
USAL-CB-PDZZZ-60-000003-000	Cause & Effect Diagram System 976/977/979 Water	Rev 0	CEII
USAL-CB-PDZZZ-70-000001-000	Cause & Effect Diagram System 634 Condensate Storage and Loading	Rev 0	CEII
USAL-CB-PDZZZ-70-000002-000	Cause & Effect Diagram System 698 Refrigerant Storage	Rev 0	CEII
USAL-CB-PDZZZ-70-000003-000	Cause & Effect Diagram System 612/613 Flare and Vent	Rev 0	CEII
USAL-CB-PDZZZ-70-000004-000	Cause & Effect Diagram System 911/964 Diesel Oil Storage & Distribution / Sludge & Waste Oil Handling	Rev 0	CEII
USAL-CB-PDZZZ-80-000001-000	Cause & Effect Diagram System 691 LNG Storage and Loading	Rev 0	CEII

Q.2 - Block Diagrams

Document Number:	Description:	Revision:	Appendix:
USAL-CB-IDBLK-00-000001-001	System Block Diagram Integrated Control and Safety System (ICSS) Architecture Preliminary	Rev 2	P&C
USAL-CB-IDBLK-00-000001-002	System Block Diagram Integrated Control and Safety System (ICSS) Architecture Preliminary	Rev 2	P&C
USAL-CB-IDBLK-00-000001-003	System Block Diagram Integrated Control and Safety System (ICSS) Architecture Preliminary	Rev 2	P&C

Q.3 - Shutdown Valve List

Document Number:	Description:	Revision:	Appendix:
USAL-CB-ILZZZ-00-000002-000	Shutdown Valve List	Rev 2	Public



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Q.4 – Drawing of ESD Manual Activation Devices

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public

Q.5 - Shutoff Valve Manufacturer's Data

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-III-TDS-DOC-00001	Sample Manufacturers Data for Shutoff Valves	0	P&C

APPENDIX 13R - RELIEF VALVES AND FLARE/VENT SYSTEMS

R.1 – Relief Valves Capacities and Sizing

Document Number:	Description:	Revision:	Appendix:
N/A	Refer to R.3, Flare and Vent Study Report	N/A	Public

R.2 – Flaring Load and Venting Capacities and Sizing

Document Number:	Description:	Revision:	Appendix:
N/A	Refer to R.3, Flare and Vent Study Report	N/A	Public

R.3 - Flare and Vent Study Report

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PRTEC-00-000004-000	Study 12.3.5.1 – Flare and Vents Study Report	Rev 4	P&C

APPENDIX 13S – SPILL, TOXIC, FIRE, AND EXPLOSION PROTECTION

S.1 - NFPA 59A Preliminary Fire Protection Evaluation

Document Number:	Description:	Revision:	Appendix:
USAL-EX-FRRSK-00-000001-000	NFPA 59A Preliminary Fire Protection Evaluation	0	P&C

S.2 - Spill Containment Sizing Matrix

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FRZZZ-00-000005-000	Hydrocarbon Spill Containment Sizing Report	Rev 3	P&C



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S.3 - Spill Containment Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-CDDRN-00-000999-001	LNG Spill Containment Trench and Sump Key Plan Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000999-002	LNG Spill Containment Trench and Sump Plan - Area 1 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000999-003	LNG Spill Containment Trench and Sump Plan - Area 2 Layout	Rev 1	CEII
USAL-CB-CDDRN-00-000999-101	LNG Spill Containment Trench and Sump Sections and Details Layout	Rev 1	CEII

S.4 – Passive Protection Drawings

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested and needed	N/A	Public

S.5 - Hazard Detection Matrix

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FLMEL-00-000001-000	Fire and Gas Detection Equipment List	Rev 1	Public

S.6 - Hazard Detection Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FDFGS-00-000003-001	Fire & Gas Detection Equipment Layout BOG Compressor Area	Rev 1	CEII
USAL-CB-FDFGS-00-000003-002	Fire & Gas Detection Equipment Layout Admin Area	Rev 1	CEII
USAL-CB-FDFGS-00-000003-003	Fire & Gas Detection Equipment Layout Condensate Truck Loading Area	Rev 2	CEII
USAL-CB-FDFGS-00-000003-004	Fire & Gas Detection Equipment Layout Diesel/Condensate Storage Area	Rev 1	CEII
USAL-CB-FDFGS-00-000003-005	Fire & Gas Detection Equipment Layout Flare K.O. Drum Area	Rev 1	CEII
USAL-CB-FDFGS-00-000003-006	Fire & Gas Detection Equipment Layout LNG Process Train 1 (ISBL)	Rev 1	CEII
USAL-CB-FDFGS-00-000003-007	Fire & Gas Detection Equipment Layout Offshore Trestle Area	Rev 1	CEII
USAL-CB-FDFGS-00-000003-008	Fire & Gas Detection Equipment Layout Refrigerant Storage Area	Rev 1	CEII
USAL-CB-FDFGS-00-000003-009	Fire & Gas Detection Equipment Layout LNG Impoundment Sump	Rev 1	CEII
USAL-CB-FDFGS-00-000003-010	Fire & Gas Detection Equipment Layout Ship Berth 1	Rev 2	CEII
USAL-CB-FDFGS-00-000003-011	Fire & Gas Detection Equipment Layout Ship Berth 2	Rev 2	CEII



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USAL-CB-FDFGS-00-000003-012	Fire & Gas Detection Equipment Layout LNG Storage Tank (810)	Rev 1	CEII
USAL-CB-FDFGS-00-000003-013	Fire & Gas Detection Equipment Layout LNG Storage Tank (820)	Rev 1	CEII
USAL-CB-FDFGS-00-000003-015	Fire & Gas Detection Equipment Layout LNG Process Train 2 (ISBL)	Rev 1	CEII
USAL-CB-FDFGS-00-000003-016	Fire & Gas Detection Equipment Layout LNG Process Train 3 (ISBL)	Rev 1	CEII
USAL-CB-FDFGS-00-000003-017	Fire & Gas Detection Equipment Layout Power Generation Area	Rev 1	CEII
USAL-CB-FDFGS-00-000003-021	Fire & Gas Detection Equipment Layout North Gate	Rev 1	CEII
USAL-CB-FDFGS-00-000003-022	Fire & Gas Detection Equipment Layout Inlet Gas Treating Area	Rev 0	CEII
USAL-CB-FDFGS-00-000003-023	Fire & Gas Detection Equipment Layout HP & LP Fuel Area	Rev 0	CEII
USAL-CB-FDFGS-00-000003-024	Fire & Gas Detection Equipment Layout Nitrogen and Plant Air / Instrument Air Area	Rev 0	CEII
USAL-CB-FDFGS-00-000003-025	Fire & Gas Detection Equipment Layout Fractionation Area	Rev 0	CEII
USAL-CB-FDFGS-00-000003-026	Fire & Gas Detection Equipment Layout Waste Water Treatment Area	Rev 0	CEII
USAL-CB-FDFGS-00-000003-027	Fire & Gas Detection Equipment Layout Non-Hydrocarbon Utility Area	Rev 0	CEII

S.7 - Hazard Control Matrix

Document Number:	Description:	Revision:	Appendix:
USAL-CB-MLMEL-00-000001-000-A	Hazard Control and Safety Equipment List	Rev 1	Public

S.8 - Hazard Control Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FDLAY-00-000001-000	Escape Route and Safety Equipment Layout Overall Layout	Rev 1	CEII
USAL-CB-FDLAY-00-000001-001	Escape Route and Safety Equipment Layout LNG Trains, LNG Storage Tank, Common Process & Utility	Rev 2	CEII
USAL-CB-FDLAY-00-000001-002	Escape Route and Safety Equipment Layout Offshore Trestle	Rev 1	CEII
USAL-CB-FDLAY-00-000001-003	Escape Route and Safety Equipment Layout Admin, Condensate & Diesel Storage and Waste Water Treatment	Rev 1	CEII
USAL-CB-FDLAY-00-000001-005	Escape Route and Safety Equipment Layout North Gate	Rev 1	CEII
USAL-CB-FDLAY-00-000001-008	Escape Route and Safety Equipment Layout Process Train (ISBL)	Rev 1	CEII



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Document Number:	Description:	Revision:	Appendix:
	Escape Route and Safety Equipment Layout Power Generation, Non– Hydrocarbon Utility, Open Ground Flare, Inlet Gas Treating and HP & LP Fuel	Rev 1	CEII

S.9 – Fire Water Matrix

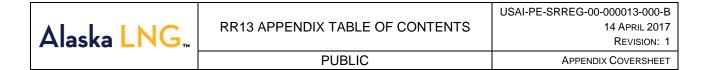
Document Number:	Description:	Revision:	Appendix:
USAL-CB-FLZZZ-00-000009-000	Fireproofing Equipment List	Rev 3	P&C
USAL-CB-FLZZZ-00-000005-000	Firefighting Equipment List	Rev 1	P&C

S.10 - Firewater Drawings

Document Number:	Description:	Revision:	Appendix:
USAL-CB-FDFGS-00-000001-001	Fire Fighting Equipment Layout (Coverage + Pipe Plans) LNG Trains, LNG Storage Tank, Common Process & Utility	Rev 2	CEII
USAL-CB-FDFGS-00-000001-002	Fire Fighting Equipment Layout (Coverage + Pipe Plans) Offshore Trestle	Rev 2	CEII
USAL-CB-FDFGS-00-000001-008	Fire Fighting Equipment Layout (Coverage + Pipe Plans) Admin, Condensate & Diesel Storage and Waste Water Treatment	Rev 1	CEII
USAL-CB-FDFGS-00-000001-009	Fire Fighting Equipment Layout (Coverage + Pipe Plans) Power Generation, Non-Hydrocarbon Utility, Open Ground Flare, Inlet Gas Treating and HP & LP Fuel	Rev 2	CEII

S.11 - Fire Exposed Area Drawings

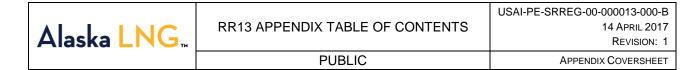
Document Number:	Description:	Revision:	Appendix:
USAL-CB-FDZZZ-00-000001-001	Fire Exposed Area Layout LNG Trains, LNG Storage Tank, Common Process & Utility	Rev 1	CEII
USAL-CB-FDZZZ-00-000001-002	Fire Exposed Area Layout Offshore Trestle	Rev 1	CEII
USAL-CB-FDZZZ-00-000001-003	Fire Exposed Area Layout Admin, Condensate & Diesel Storage and Waste Water Treatment	Rev 1	CEII
USAL-CB-FDZZZ-00-000001-008	Fire Exposed Area Layout Process Train (ISBL)	Rev 1	CEII
USAL-CB-FDZZZ-00-000001-009	Fire Exposed Area Layout Power Generation, Non-Hydrocarbon Utility, Open Ground Flare, Inlet Gas Treating and HP & LP Fuel	Rev 1	CEII



APPENDIX 13T – TECHNOLOGY, PROCESS, AND EQUIPMENT SELECTION AND ALTERNATIVES

T.1 - LNG Tank Technology Report

Document Number:	Description:	Revision:	Appendix:
USAL-CB-PRTEC-00-000025-000	Study 12.3.21 – LNG Tank Technology Study Report	Rev 1	P&C



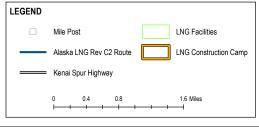
APPENDIX 13A - PROJECT MANAGEMENT

A.1 - Site Location Maps and Drawing

Document Number:	Description:	Revision:	Appendix:	
Figure 3_2_1-1 Liquefaction Facility Area Plan	Liquefaction Facility Area Plan	N/A	Public	
USAL-CB-LDLAY-00-00003-000	LNG Liquefaction Facility – Overall Complex Site Plan	Rev 6	Public	







DISCLAIMER

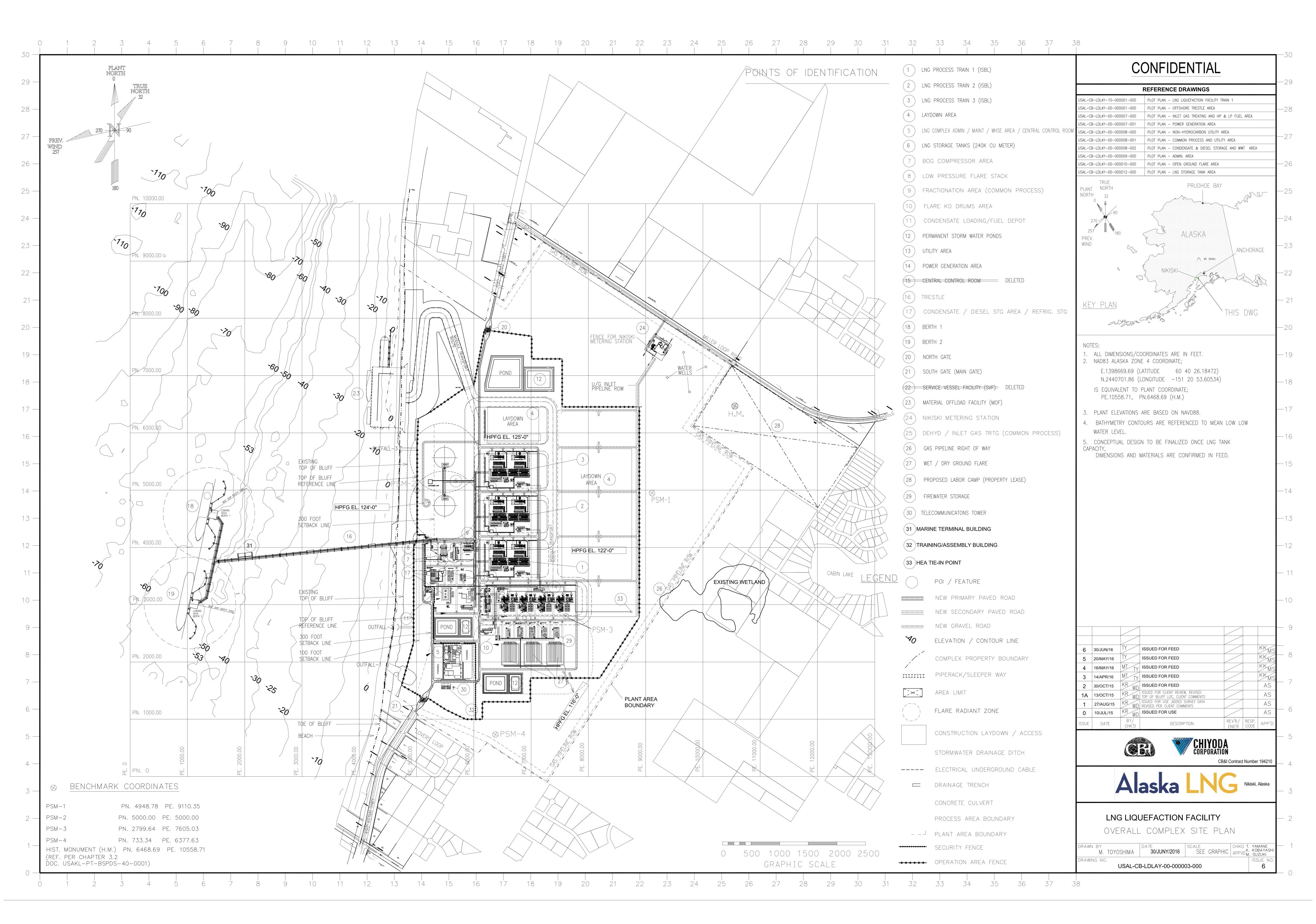
The information contained herein is for informational or planning purposes only, it does not nor should it be deemed to be an offer, request or proposals for rights or occupation of any kind. The Alakas LING Project Participants and their respective officers, employees and agents, make no warranty, implied or otherwise, nor accept any lability, as to the accuracy or completeness of the information contained in these documents, drawings or electronic files. Do not remove or delete this note from document, drawing or electronic file.

PREPARED	BY:	AGDO)	
SCALE:		1:7	5,000	
DATE:	2017-	03-07	SHEET:	1 of 1

LIQUEFACTION FACILITY AREA PLAN

APPENDIX A.1



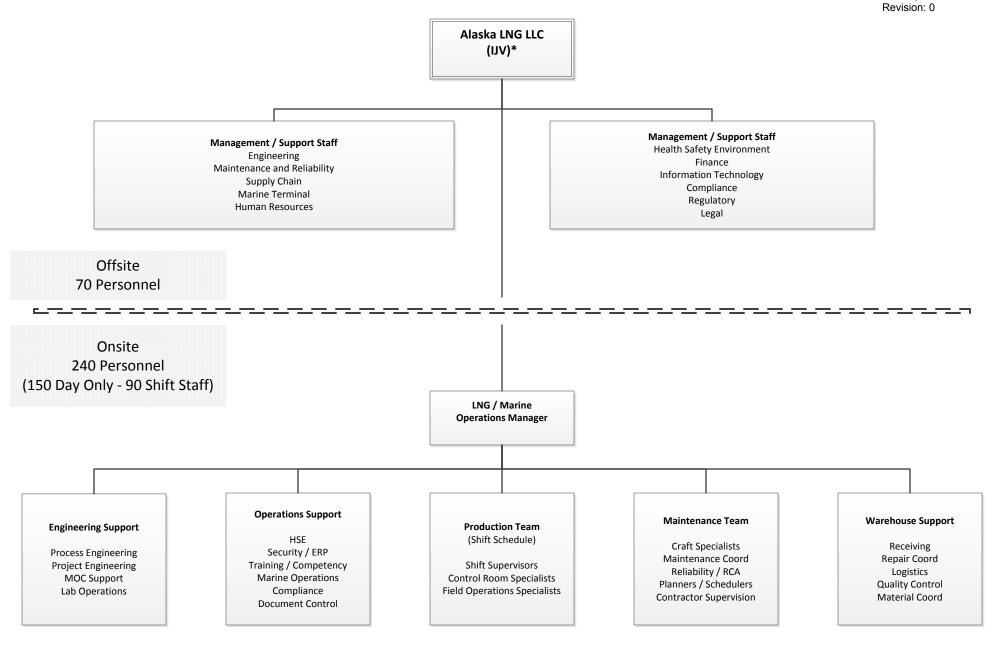




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A.2 - Organization Chart

Document Number:		Description:	Revision: Append		
US	SAL-PL-BAORG-00-000001-000	Organizational Chart	0	Public	



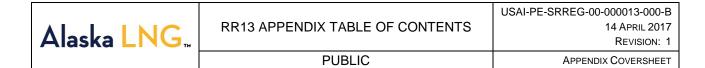
(IJV)* – Integrated Joint Venture



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A.3 – Construction Workforce Organizational Chart*

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N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public	



A.4 - Operation Workforce Organizational Chart*

Document Number:		Description:	Revision:	Appendix:
	N/A	An asterisk (*) denotes information that is optional and can be provided in final design.	N/A	Public



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A.5 - Project Schedule

Document Number:		Description: Revision: Ap			
	USAI-PT-BYSCH-00-000001-000	Integrated Project Summary Schedule	Rev 0A	Public	



INTEGRATED PROJECT SUMMARY SCHEDULE

USAI-PT-BYSCH-00-000001-000

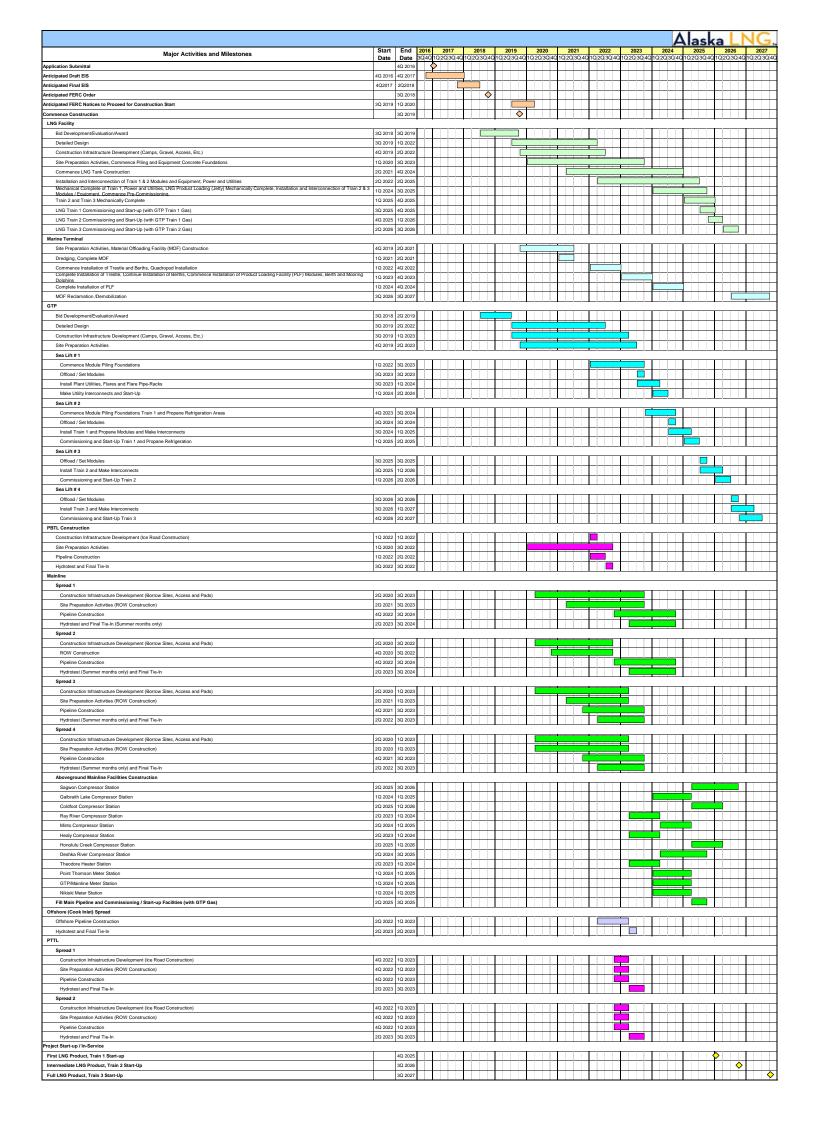
Rev	Date	Revision Description		Originator			iewer / dorser	Response Code	Appr	over
0	11-May-16	Issued for Use		P. Connor						
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Do	cument	Country	Facility	Originator	Discipline	Type	Sub-Type	Location	Sequence	Identifier
Со	ntrol No.	US	Al	PT	В	Υ	SCH	00	000001	000



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Major Milestones	Start Date	End Date
Application Submittal		4Q 2016
Anticipated Draft EIS	4Q 2016	4Q 2017
Anticipated Final EIS	4Q2017	2Q2018
Anticipated FERC Order		3Q 2018
Anticipated FERC Notices to Proceed for Construction Start	3Q 2019	1Q 2020
Commence Construction		
LNG Facility		
Bid Development/Evaluation/Award	3Q 2018	3Q 2019
Detailed Design	3Q 2019	1Q 2022
Construction Infrastructure Development (Camps, Gravel, Access, Etc.)	4Q 2019	2Q 2022
Site Preparation Activities, Commence Piling and Equipment Concrete Foundations	1Q 2020	3Q 2023
Commence LNG Tank Construction	2Q 2021	4Q 2024
Installation and Interconnection of Train 1 & 2 Modules and Equipment, Power and Utilities	2Q 2022	2Q 2025
Mechanical Complete of Train 1, Power and Utilities, LNG Product Loading (Jetty) Mechanically Complete, Installation and Interconnection of Train 2 & 3 Modules / Equipment, Commence Pre-Commissioning.	1Q 2024	3Q 2025
Train 2 and Train 3 Mechanically Complete	1Q 2025	4Q 2025
LNG Train 1 Commissioning and Start-up (with GTP Train 1 Gas)	3Q 2025	4Q 2025
LNG Train 2 Commissioning and Start-Up (with GTP Train 1 Gas)	4Q 2025	1Q 2026
LNG Train 3 Commissioning and Start-Up (with GTP Train 2 Gas)	2Q 2026	3Q 2026
Marine Terminal		
Site Preparation Activities, Material Offloading Facility (MOF) Construction	4Q 2019	2Q 2021
Dredging, Complete MOF	1Q 2021	2Q 2021
Commence Installation of Trestle and Berths, Quadropod Installation	1Q 2022	4Q 2022
Complete Installation of Trestle, Continue Installation of Berths, Commence Installation of Product Loading Facility (PLF) Modules, Berth and Mooring Dolphins	1Q 2023	4Q 2023
Complete Installation of PLF	1Q 2024	4Q 2024
MOF Reclamation /Demobilization	3Q 2026	3Q 2027
GTP		
Bid Development/Evaluation/Award	3Q 2018	2Q 2019
Detailed Design	3Q 2019	2Q 2022
Construction Infrastructure Development (Camps, Gravel, Access, Etc.)	3Q 2019	1Q 2023
Site Preparation Activities	4Q 2019	2Q 2023
Sea Lift # 1		
Commence Module Piling Foundations	1Q 2022	3Q 2023
Offload / Set Modules	3Q 2023	3Q 2023
Install Plant Utilities, Flares and Flare Pipe-Racks	3Q 2023	1Q 2024
Make Utility Interconnects and Start-Up	1Q 2024	2Q 2024
Sea Lift # 2		
Commence Module Piling Foundations Train 1 and Propane Refrigeration Areas	4Q 2023	3Q 2024
Offload / Set Modules	3Q 2024	3Q 2024
Install Train 1 and Propane Modules and Make Interconnects	3Q 2024	1Q 2025
Commissioning and Start-Up Train 1 and Propane Refrigeration	1Q 2025	2Q 2025
Sea Lift # 3		
Offload / Set Modules	3Q 2025	3Q 2025
Install Train 2 and Make Interconnects	3Q 2025	1Q 2026
Commissioning and Start-Up Train 2	1Q 2026	2Q 2026
Sea Lift # 4		

Offload / Set Modules	3Q 2026	3Q 2026
Install Train 3 and Make Interconnects	3Q 2026	1Q 2027
Commissioning and Start-Up Train 3	4Q 2026	2Q 2027
PBTL Construction	1	
Construction Infrastructure Development (Ice Road Construction)	1Q 2022	1Q 2022
Site Preparation Activities	1Q 2020	3Q 2022
Pipeline Construction	1Q 2022	2Q 2022
Hydrotest and Final Tie-In	3Q 2022	3Q 2022
Mainline		
Spread 1		
Construction Infrastructure Development (Borrow Sites, Access and Pads)	2Q 2020	3Q 2023
Site Preparation Activities (ROW Construction)	2Q 2021	3Q 2023
Pipeline Construction	4Q 2022	3Q 2024
Hydrotest and Final Tie-In (Summer months only)	2Q 2023	3Q 2024
Spread 2		
Construction Infrastructure Development (Borrow Sites, Access and Pads)	2Q 2020	3Q 2022
ROW Construction	4Q 2020	3Q 2022
Pipeline Construction	4Q 2022	3Q 2024
Hydrotest (Summer months only) and Final Tie-In	2Q 2023	3Q 2024
Spread 3		
Construction Infrastructure Development (Borrow Sites, Access and Pads)	2Q 2020	1Q 2023
Site Preparation Activities (ROW Construction)	2Q 2021	1Q 2023
Pipeline Construction	4Q 2021	3Q 2023
Hydrotest (Summer months only) and Final Tie-In	2Q 2022	3Q 2023
Spread 4		
Construction Infrastructure Development (Borrow Sites, Access and Pads)	2Q 2020	1Q 2023
Site Preparation Activities (ROW Construction)	2Q 2020	1Q 2023
Pipeline Construction	4Q 2021	3Q 2023
Hydrotest (Summer months only) and Final Tie-In	2Q 2022	3Q 2023
Aboveground Mainline Facilities Construction	•	
Sagwon Compressor Station	2Q 2025	3Q 2026
Galbraith Lake Compressor Station	1Q 2024	1Q 2025
Coldfoot Compressor Station	2Q 2025	1Q 2026
Ray River Compressor Station	2Q 2023	1Q 2024
Minto Compressor Station	2Q 2024	1Q 2025
Healy Compressor Station	2Q 2023	1Q 2024
Honolulu Creek Compressor Station	2Q 2025	1Q 2026
Deshka River Compressor Station	2Q 2024	3Q 2025
Theodore Heater Station	2Q 2023	1Q 2024
Point Thomson Meter Station	1Q 2024	1Q 2025
GTP/Mainline Meter Station	1Q 2024	1Q 2025
Nikiski Meter Station	1Q 2024	1Q 2025
Fill Main Pipeline and Commissioning / Start-up Facilities (with GTP Gas)	2Q 2025	3Q 2025
Offshore (Cook Inlet) Spread	•	•
Offshore Pipeline Construction	2Q 2022	1Q 2023
Hydrotest and Final Tie-In	2Q 2023	2Q 2023
PTTL	•	-
Spread 1		
Construction Infrastructure Development (Ice Road Construction)	4Q 2022	1Q 2023

Site Preparation Activities (ROW Construction)	4Q 2022	1Q 2023
Pipeline Construction	4Q 2022	1Q 2023
Hydrotest and Final Tie-In	2Q 2023	3Q 2023
Spread 2		
Construction Infrastructure Development (Ice Road Construction)	4Q 2022	1Q 2023
Site Preparation Activities (ROW Construction)	4Q 2022	1Q 2023
Pipeline Construction	4Q 2022	1Q 2023
Hydrotest and Final Tie-In	2Q 2023	3Q 2023
Project Start-up / In-Service		
First LNG Product, Train 1 Start-up		4Q 2025
Intermediate LNG Product, Train 2 Start-Up		3Q 2026
Full LNG Product, Train 3 Start-Up		3Q 2027

Notes:

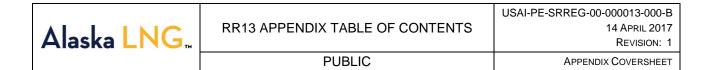
Construction Quarters (Q)

1Q = Jan-01 to Mar-31

2Q = Apr-01 to June-30

3Q = Jul-01 to Sept-30

4Q = Oct-31 to Dec-31



APPENDIX 13C - REGULATIONS AND PERMITS

C.1 – Table of Regulatory Agencies, Permits, and Approvals

Document Number:	Description:	Revision:	Appendix:
USAL-CB-SPREG-00-000001-000	Permit Matrix	Rev 0	Public

Alaska LNG



Permit Matrix

USAL-CB-SPREG-00-000001-001

Rev	Date	_	sion iption	Originator		_	iewer / dorser	Response Code	Appr	over
0	27-May-15	Issued for Use		J. Christopher R. Bayliss					D. Luk	omski
Do	cument	Country	Facility	Originator	Discipline	Type	Sub-Type	Location	Sequence	Identifier
Co	ntrol No.	US	AL	СВ	S	Р	REG	00	000001	001



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HOLD LIST

Hold	Comment



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All Permits	
Acronyms	

Permit or Plan:	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity Federal Permits	Pre- FEED & Appro		EPC	Suggested Submittal Date^	Data Needs	Comments
Authorization to Construct, Operate or Modify Facilities Used for the Export or Import of Natural Gas (Presidential Finding); FERC	AKLNG		2-3 yr.	Liquefaction Terminal	NA NA				To construct, operate, or modify facilities used for the export or import of natural gas. Includes the analysis by the Department of Energy for an LNG export license.		x		Q4 2016	Section 3(b) Application Application for Presidential Permit Sponsor Finances Financial and Corporate relationship Environmental Report Liquefaction Facility Map and Ownership Resource Reports	FERC dictates the scheduling requirements for the NEPA EIS. FERC will use the Resource Reports to develop the EIS. DOE will complete their analysis and provide to the FERC for inclusion in the Section 3 license. Related, non-jurisdictional facilities will be required to be addressed in the Section 3 application for completion of the cumulative impacts analysis of the entire project, not just the Liquefaction Facility. Each asset will be addressed to the same level of detail as the Liquefaction Facility in each Resource Report
NEPA EIS; FERC Lead Federal Agency	AKLNG		2-3 yr.	Liquefaction Terminal	NA			National Environmental Policy Act of 1969; Public Law 91-190, 42 USC §4321-4327, January 1, 1970, as amended; Council on Environmental Quality, 40 CFR §1502.9; 15 USC 719(n)(c)(3) Alaska Natural Gas Pipeline Act (ANGPA); Alaska National Interest Land Conservation Act (ANILCA, P.L. 96-487).	A detailed statement of environmental effects of the project prepared by FERC that details reasonable project alternatives to minimize potentially adverse impacts to the human and natural environment, and provides public disclosure of the environmental impacts associated with federal actions.		x		Q2 2016	Purpose and need Alternatives Description Information provided in the FERC Resource Reports used to develop Affected Environment and Environmental Consequences Evaluation of direct, indirect, and cumulative impacts. Upstream and midstream footprints and facility impacts will be addressed as cumulative impacts as non-jurisdictional related facilities.	FERC will be the lead federal agency. FERC will coordinate with other federal agencies that require NEPA documentation prior to issuance of their respective permits. Level of detail required for NEPA markedly different than for permits. FERC has indicated the need for detailed, location specific subsistence, HIA, Traditional Knowledge, and other socioeconomic data. G&PA to monitor Congressional activities surrounding expanding ANGPA to address Alaska LNG export project.
Wetlands Dredge or Fill Permit (Section 404); U.S. Army Corps of Engineers (USACE)	AKLNG		1-2 Yr.	Liquefaction Terminal	\$100 for all 3 authorities Section 404, 10, 103	5 yr; Extension if needed will be new fee		Clean Water Act (CWA), Section 404, 33 USC §1344; 33 CFR 320-332;	Authorizes the discharge of diredge or fill material into federally designated wetlands and waters of the United States.		х		Q2 2016	Description of project activity Location information Requires identification of quantity and footprint of fill material for the pad, roads, and pipeline support Requires identification of quantity of dredge material, dredge, and disposastites Section 404 requires wetlands delineation, jurisdictional determination, and compensatory mitigation plan	Dredged material in marine waters must be placed nearby the project footprint or in an ocean disposal site USACE can issue multiple permits for the same activity in the same area as long as one NEPA document covers all the permitted activities Requires completion of the EIS process and a signed ROD from USACE Requires sciencion of the Least Environmentally Damaging Practicable Alternative [Section 404 (b)(1) analysis] Permit application process includes a minimum 30-day public comment period Beneficial uses include beach nourishment and site preservation

Permit Matrix

Permit or Plan:	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED		EPC	Suggested Submittal Date^	Data Needs	Comments
Navigable Waters Permit (Section 10); USACE	AKLNG		1-2 Yr.	Liquefaction Terminal		determined by initial permit; if 5 yr; Extension if needed will be new fee		Rivers and Harbors Act of 1899, § 10, 33 USC §403;			x			 Section 10 permit is necessary for dock improvements and dreding at West Dock and Nikiski, potentially major river crossings, Cook Inlet crossing, and construction in navigable waters 	
Ocean Disposal Permit (Section 103); USACE; EPA	AKLNG		1-2 Yr.	Liquefaction Terminal		determined by initial permit; if 5 yr; Extension if needed will be new fee		Sanctuaries Act	Authorizes transport and discharge of dredge material into territorial seas/marine waters.		x			studies of ocean dump area including aqueous and sediment samples, benthic invertebrate and fish studies, tissue samples, and hydrographic and bathymetry studies • Requires completion of the EIS process	Requires consideration of the need for and environmental effects of the proposed dumping. USACE is permitting authority for dredged material disposal; EPA establishes dumping criteria and designates ocean dump sites (permanent sites).

					Application				1		1				
			Estimated		Cost (Does										
	Contractor or		Time for		Not Include		Total Cost						Suggested		
Permit or Plan:	Responsible	Contract	Permit	Project	Mitigation	Frequency	per	Statute /		Pre-			Submittal		
Agency#	Party*	Reference	Approval	Phase	Fees)	of Permit	Installment	Regulation	Activity	FEED		EPC	Date^	Data Needs	Comments
Waterway Sultabilit Analysis; USCG	y AKLNG		9-12 month lead time in conjunction with FERC prefiling process; Letter of Recommenda tion (LOR) issued prior to DEIS; Per NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 05-05	Liquefaction Terminal	NA NA	NA		33 CFR Part 104; 33 CFR Part 105; U.S. Department of Department of Homeland Security 33 CFR 127, Waterfront Facilities Handling LNG and Liquefied Hazardous Gas (Liquefaction Facility) U.S. Coast Guard 33 CFR 127, Letter of Intent (Liquefaction Facility) Permission to Establish Aids to Navigation (Marine Terminal) Waterway Suitability Assessments - NVIC 05-05	Prepare and submit a 1) letter of intent that describes the planned LNG facility, and 2) Preliminary Waterway Suitability Assessment (WSA) for the proposed LNG marine traffic.		x		Q3 2017	Alaska LNG prepares and submits a letter of intent that describes the planned LNG facility, ships that will call in, the frequency of their calls, and the detailed nature of the waterway Alaska LNG prepares Preliminary Waterway Suitability Assessment (WSA) for the proposed LNG marine traffic (2013) and a follow-on WSA for inclusion with the FERC filing (2015) The Preliminary WSA should address the major impacts of Alaska LNG operations on any port facilities The follow-on USA should identify credible security threats and safety hazards to LNG marine transportation and identify appropriate risk management procedures	Complete WSA so that Letter of Recommendation (LOR) issued prior to DEIS; USCG issues LOR (prior to DEIS) Applicants are encourage to coordinate with the appropriate USCG Captain of the Port when developing the WSA
Underground Injection Control (UIC) Program; EPA	AKLNG		Class I - 3 -6 months - application at a "reasonable" time before construction,	Liquefaction Terminal	\$275	NA		40 CFR 144 Underground Injection Control Program. AOGCC administers the Class II well program per 40 CFR § 147.100	Authorizes disposal of industrial waste into naturally saline groundwater, beneath any aquifers, which could serve as current or future USDWs.			×	Q3 2018	Owner information and SIC code Legal information Well status and type of permit Class and type of well Class and type of well Class and type of well Corrective action plan and well data Maps of well / area of review Corrective action plan and well data Maps and cross section of underground sources of drinking water (USDWs) Name and depth of USDWs Maps and cross sections of geologic structure of area Geological data of inject. and confining zones Operating data Formation testing program Stimulation program Stimulation program Injection procedures Construction procedures Construction procedures Changes in injected fluid Plan for well failures Monitoring program Plugging and abandonment plan Aquifer exemptions	Class I injection wells are used for the deep disposal of industrial waste into naturally saline groundwater, beneath any aquifers, which could serve as current or future USDWs. Alaska Department of Environmental Conservation (ADEC) requires a Notice of Disposal with proposed flow-rates of maximum and average gallons per day and total injection volume in gallons in accordance with 18 Alaska Administrative Code (AAC) 72. ADEC Wastewater Disposal General Permit (2005DB0001) is available for use by owners/operators who have been issued a Class I injection well permit by the EPA.

			Estimated		Cost (Does										
	Contractor or		Time for		Not Include		Total Cost						Suggested		
Permit or Plan:	Responsible	Contract	Permit	Project	Mitigation	Frequency		Statute /		Dro-	FEE		Submittal		
Agency#	Party*	Reference	Approval	Phase	Fees)	of Permit	Installment	Regulation	Activity	FEED		EPC		Data Needs	Comments
Hazardous Waste	AKLNG		6-9 mo.	Liquefaction	1 663)	OI F ellillit	mstamment	Resource	Applicable to the	ILLD		Y		RCRA Hazardous Waste Part A Permit Application (EPA Form 8700-23)	There are no designated RCRA hazardous
Management	AKLING		0-9 1110.	Terminal				Conservation and	generation.				Q2 2016	and RCRA Part B:	waste disposal sites in Alaska.
Facility Permit;				Terminal				Recovery Act	transport,					Site name, location, land type, EPA Identification Number, and NACS	waste disposal sites III Alaska.
EPA								(RCRA); 42 USC	treatment,					Code(s)	
L' ^								6901 et seq.; 40	storage, and					 Facility existence dates, other environmental permits and permit numbers, 	
								CFR 124;	disposal of					nature of business	
								40 CFR 260-271	hazardous					Description of hazardous waste and regulated waste activities	
								40 011(200 271	wastes.					A Hazardous Waste Report	
									madico.					Topographic maps of the area extending to at least 1 mile beyond property	,
														boundaries of the facility, and hazardous waste management, water	
														sources, and wells within 1/4 mile	ļ l
														Facility drawing with property boundaries, areas occupied by storage,	
														treatment, or disposal operations that will be used during interim status,	ļ l
														name of each operation (e.g., drum storage area), areas of past use, areas	
														of future use, and the approximate dimensions of the property boundaries	
														and all storage, treatment, and disposal areas	
														Waste Analysis Plan and Chemical and physical analysis of the	
														hazardous waste and hazardous debris to be handled at the facility	
														Description of security procedures and equipment and general inspection	
														schedule and contingency plan	
														Description of procedures, structures or equipment to be used at the	
														facility to prevent hazards, flooding, contamination of water supplies or the	
														atmosphere	
														 Precautions to prevent accidental ignition or reaction of ignitable, reactive, 	
														or incompatible wastes	
														Traffic pattern, estimated volume (number, types) of vehicles, and control	
														Facility location information relative to faults and floodplains	
						1				1				Training programs	
						1				1				Closure Plan, where applicable, and Post-closure Plan	
						1				1				Cost estimate for facility	
						1									
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Permit Matrix CONFIDENTIAL

			F-thursted		Application										
	Contractor or		Estimated Time for		Cost (Does Not Include		Total Cost						Suggested		
Permit or Plan:	Responsible	Contract	Permit	Project	Mitigation	Frequency	per	Statute /		Pre-	FEE		Submittal		
Agency#	Party*	Reference	Approval	Phase	Fees)	of Permit	Installment	Regulation	Activity	FEED	D	EPC	Date^	Data Needs	Comments
Spill Prevention, Control, and Countermeasure (SPCC) Plan; EPA or U.S. Coast Guard (USCG)	AKLNG		Reviewed prior to construction; draft in EIS.	Liquefaction Terminal	NA	NA			Plan written to prevent the discharge of oil into navigable waters or adjoining shorelines. Emphasis on prevention rather than mitigation measures provided in contingency plans. EPA - regulatory and enforcement role for oil spill prevention activities under CWA section 311 for onshore and near shore nontransportation related facilities landward of the coastline.		x	x	Q3 2015	Identify all individual storage tanks with a capacity greater than 660 gallons, or multiple tank or drum fuel storage with a combined capacity greater than 1,320 gallons	SPCC Plans must be certified by a registered professional engineer. Applicable for construction and operations activities Review and approval required by the USCG for facilities with threat of petroleum spill to navigable waters of the U.S. Review and approval required by EPA for facilities with threat of petroleum spill into all other waters of the U.S. Required for project facilities with petroleum storage of an aggregate capacity greater than 1,320 gallons or completely buried with a capacity greater than 42,000 gallons; and, due to facility location, could reasonably be expected to be harmful, as described in 40 C.F.R. part 110, into or upon navigable waters of the US or adjoining shorelines.
Endangered Species Act (ESA) Section 7 Consultation; U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS)	AKLNG/Feder al Agency		Consultation — simultaneous with EIS	Liquefaction Terminal	NA	NA		ESA, § 7(a)(2); 16 USC § 1531-1544	Consultation in conjunction with the EIS process and USACE Section 404/10/103 permitting.	х	х	х	Q3 2015	Consultation with USFWS and NMFS Preparation of Biological Assessment to accompany the FERC application Also required on individual permits for field studies and access. Section 7 review can take 135 days	
Migratory Bird Treaty Act (MBTA); USFWS	AKLNG		Consultation — simultaneous with EIS	Liquefaction Terminal	NA	NA		MBTA 16 USC § 703- 712	Consultation in conjunction with the EIS process and USACE Section 404/10/103 permitting.	х	x	х	Q3 2015	Consultation with USFWS Complete Avian Protection Plan with FERC application Undertake permitting under Special Purpose permit provisions of MBTA (50 CFR 21.27)	Timing windows for clearing and grubbing activities will be included in the Section 404 (USACE) permit.
Bald and Golden Eagle Take Permit pursuant to Bald and Golden Eagle Protection Act (BGEPA); USFWS	AKLNG		Consultation — simultaneous with EIS; 60 days	Liquefaction Terminal	NA	NA		BGEPA 16 USC 668 668d, as amended;, 50 CFR 22.25; 50 CFR 13	Consultation in conjunction with the EIS process	х	х	х	Q3 2015	Consultation with USFWS Conduct studies as recommended by the USFWS including eagle and raptor nest surveys	Early coordination with USFWS regarding data collection requirements and timing windows for construction activities is recommended.

Permit or Plan: Agency [#]	Contractor or Responsible Party*	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED		Suggested Submittal Date^	Data Needs	Comments
Essential Fish Habitat (EFH) Consultation; NMFS	AKLNG		Liquefaction Terminal	NA NA	NA		Conservation and Management Act / Sustainable Fisheries Act, 16 USC § 1801 et seq.	Consultation with NMFS and assess the effects of project actions on EFH; EFH must be addressed as part of the EIS process.		*		Preparation of EFH Assessment with FERC application Required for APDES and NPDES permits for waste water treatment and disposal	 Applies to some marine fish and anadromous fish species which spend a portion of their life history activities in marine waters. Marine waters in Cook Inlet are designated as EFH. Water source selected for use during facility operations will be scrutinized for EFH. May require fieldwork.

Permit or Plan: Agency#	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	FEE D	EPC	Suggested Submittal Date^	Data Needs	Comments
Marine Mammal Protection Act (MMPA) Incidental, Harassment Authorization (IHA) or Letter of Authorization (LOA); NMFS and USFWS	AKLNG		Consultation — simultaneous with EIS; Can take 6-18 months to receive authorization.	Liquefaction Terminal	NA	NA		MMPA, Title 1, 16. USC §1371 50 CFR 101(a)(5); 50 CFR §216; 50 CFR §18	IHA Document written for Authorizations for activities that may result in harassment to a marine mammals. LOA document written for Activities that may result in harassment and planned for multiple years. Associated with any dredging and dock improvement activities and potential impacts to marine mammals in Cook Inlet.		x		Q4 2016	Dates and duration of activities Species and number of marine mammals likely to be found in activity area Species are stocks of marine mammals Description of the status, distribution, and seasonal distribution of affected species or stocks of marine mammals Type of incidental taking auth. requested Number of marine mammals by age, sex, and reproductive condition Anticipated impact of the activity upon the species or stock Anticipated impact of the activity on the availability of the species or stocks of marine mammals for subsistence use Anticipated impact of the activity on the habitat of marine mammal populations Anticipated impact of the loss or modification of the habitat on the marine mammal populations Anticipated impact of the loss or modification of the habitat on the marine mammal populations Availability and feasibility of equipment, methods, and manner of conducting such an activity Plan of cooperation Monitoring and reporting methods Means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects	III-IAs are effective for up to one year LOAs are effective for up to five consecutive years LOAs require a rulemaking process and a longer lead time, including two public notice periods. Finding of no significant impact (FONSI) required for authorization.
APDES Permit ; ADEC Noncontact Cooling NPDES Permit* **Since the project is currently proposing a design that includes air cooling rather than water (groundwater or seawater) cooling at the LNG facility, the ADEC NPDES Permit data needs are included here only in the event that the project design changes in the future.	AKLNG		1-2 years	Liquefaction Terminal				Clean Water Act; 40 CFR 125 (specifically 40 CFR.80– 125.89) 18	seawater) discharging at		x	x	Q1 2017	ADEC extends area of influence to 1/5 mile Baseline studies of receiving water biological, chemical, thermal characteristics. Source water physical data - narrative description and scaled drawings showing the physical configuration of all source water bodies used by the facility Extensive modeling of proposed discharges to predict impacts. A statement that the thermal component of the discharge is subject to effluent limitations under 33 USC 1311 and 1316, and a brief description, including a quantitative statement, of the thermal effluent limitations proposed under 33 USC 1311 and 33 USC 1316; Source water body's hydrological and geomorphological features, as well as the methods used to conduct any physical studies to determine the intake's area of influence within the water body and the results of the studies Description of the cooling water intake structure (s), including the configuration of each cooling water intake structure and its location in the water body and in the water column; -latitude and longitude in degrees, minutes, and seconds for each cooling water intake structure; - the operation of each cooling water intake structure, including design intake flows, daily hours of operation, number of days of the year in operation, and seasonal changes, if applicable; - a flow distribution and water balance diagram that includes all sources of water to the facility, recirculating flows, and discharges; - Engineering drawings of each cooling water intake structure.	Dependent upon final LNG facility design as to whether a cooling water discharge permit would be required (in lieu of injection well)—NOT PART OF DESIGN BASIS.
Determination of No Hazard to Air Navigation; Federal Aviation Administration (FAA)	AKLNG		1-3 mo.	Liquefaction Terminal	NA	NA		14 CFR § 77	Application prepared and submitted for minimizing effect on aviation.			х	Q4 2018	Description of project activity Location of activity FAA may conduct a site visit/survey in order to make the determination Applicable to the transport of tall structures on roadways	Application must be received a minimum of 30-days prior to start of construction; early coordination with FAA recommended. FAA may conduct a site visit/survey in order to make the determination Applicable to the transport of tall structures on roadways

Permit Matrix

Permit or Plan: Agency* Radio and Wire Communications Permits and Licenses; Federal Communications Commission (FCC)	Contractor or Responsible Party* AKLNG	Contract Reference	Estimated Time for Permit Approval 0-2 mo. Depending on Type	Project Phase Liquefaction Terminal	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation 47 USC 151 et seq.; 47 CFR 100 et seq.	Activity For use of interstate and foreign commerce in radio communication by wire and radio.	Pre- FEED	FEE D	EPC X	Suggested Submittal Date^ Q4 2018	Data Needs - Complete the appropriate form found on the FCC web site: http://www.fcc.gov/formpage.html	Comments Required for construction and operations
PHMSA Pipeline Special Permit	AKLNG			Liquefaction Terminal	\$2575 (\$25 processing fee)	Annual		Hazardous Materials Regulations (HMR; 49 CFR Parts 171- 180)	Authorize the transportation in commerce of certain hazardous materials			х	Q3 2015		A Special Permit sets forth alternative requirements, or variances, to the requirements in the HMR.
Bridge Permit; USCG	AKLNG		Simultaneous with EIS process; issued 3-6 months after FEIS is issued.	Liquefaction Terminal				Section 9 of the Rivers and Harbors Act of 1899 and the General Bridge Act of 1946.	For construction of a new bridge or causeway or reconstruct or modify an existing bridge or causeway across the navigable waters of the United States.			x	Q1 2018		
Surface Water Rights; Certificate of Water Appropriation; Alaska Department of Natural Resources (ADNR), Division of Mining, Land and Water (DMLW)	AKLNG		2-4 mo.	Liquefaction Terminal	\$1,200			Alaska Water Use Act, Alaska Statute (AS) 46.15; 11 AAC 93.040130, 93.210- .220	State Permits 8 For withdrawal of significant amounts of water from surface or ground water bodies for construction activities associated with permanent operations	Approv	vals x	х	Q1 2019	The application for an authorization for water rights must be made on a form approved by the department and completed in accordance with the instructions furnished to the applicant.	The water rights authorization and validate need.
Temporary Water Use Permit; Certificate of Water Appropriation; Alaska Department of Natural Resources (ADNR), Division of Mining, Land and Water (DMLW)	AKLNG/Contr actor		2-4 mo.	Liquefaction Terminal	\$350			Alaska Water Use Act, Alaska Statute (AS) 46.15; 11 AAC 93.040130, 93.210- 220	For withdrawal of significant amounts of water from surface or ground water bodies for construction activities associated with permanent operations (<5 consecutive years)		x	х		The application for an authorization for temporary water use must be made on a form approved by the department and completed in accordance with the instructions furnished to the applicant.	The temporary water use authorization can be valid for up to five years. Water is a common property resource in Alaska; water use (surface or subsurface) over 5,000 gallons per day is subject to public notice, agency evaluation, and issuance of a temporary water use permit.

Permit or Plan: Agency#	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	FEE D	EPC	Suggested Submittal Date^	Data Needs	Comments
Material Sales Permit; Alaska Department of Natural Resources (ADNR), Division of Mining, Land and Water (DMLW)	AKLNG		2-4 mo.	Liquefaction Terminal	\$100	Annual or multiyear		Alaska Land Act, Alaska Statute (AS) 38.05; 11 AAC 71	For purchase of sand, gravel, riprap, rock, limestone, slate, peat, and any other substances from the ground that are not applied for through the location system for mining claims.		х	x	Q1 2018	The material sale application form approved by the department and completed in accordance with the instructions furnished to the applicant, may also include an environmental risk questionnaire, development plan, reclamation plan, and public notice if materials are being requested from a new undeveloped site.	Three types of material sales exist: 1. Limited: cannot be for more than 200 cubic yards per 12 month period 2. Negotiated: cannot exceed 25,000 cubic yards per year per company. Material purchased under this type of sale can be sold or used for commercial purposes. 3. Competitive: sale contract can be issued for an unlimited amount of material to be taken over many years. Award determined by public auction if there are multiple bidders for the same location.
Section 401 Certification – Certificate of Reasonable Assurance; ADEC Division of Water	AKLNG		Simultaneous with USACE permitting.	Liquefaction Terminal				CWA, Section 401; 33 USC § 1344; 18 AAC 15	For discharge of stormwater and/or from underground injection control well activities and will comply with the CWA, the Alaska WQS, and other applicable State laws.		x	x	Q2 2016	USACE will notify ADEC automatically when Section 404/10/103 permit application is received	Coordination with EPA and USACE is necessary Variance request required for open cut crossings of streams and water bodies. Mixing Zone may be required to meet State Water Quality Standards. Requires an analysis with Alaska State Water Quality Standards. Must accompany Sections 10/404/103 permits and Alaska Pollutant Discharge Elimination System (APDES) stormwater permits. Also applicable to EPA Class I Underground Injection Control (UIC) wells.
APDES General Permit (GP) for Stormwater Associated with Large and Small Construction Activities for Alaska Construction; General Permit (CGP); ADEC, Division of Water	AKLNG/Const ruction Contractor		2-4 wk.	Liquefaction Terminal	\$1,480	Annual		CWA § 402; 33 USC §1342; 40 CFR §122 NPDES; 18 AAC 83 APDES	allows for			x	Q3 2018	Stormwater Pollution Prevention Plan (SWPPP) A Notice of Intent (NOI) to gain coverage under the GP	ADEC through the APDES program assumed primacy for the Stormwater Permitting Program on October 31, 2009; ADEC has stated the process will remain the same as the one currently used by EPA for the foreseeable future. Project disturbs greater than 1-acre and therefore requires a permit.

	Contractor or		Estimated Time for		Cost (Does		Total Cost						Suggested		
Permit or Plan:	Responsible	Contract	Permit	Project	Mitigation	Frequency	per	Statute /		Pre-	FEE		Submittal		
Agency* SWPPP: ADEC, Division of Water	Party* AKLNG/Const ruction Contractor	Reference	Approval Reviewed prior to construction; draft in EIS. Submit an original, signed Notice of Intent (NOI) to ADEC, at least 7 days before construction begins.	Phase Liquefaction Terminal	Fees) NA	of Permit	Installment	Regulation CWA 33 USC 1251 et seq. § 402 (I)(2); ADEC approval under CWA Section 401; 18 AAC 72 Wastewater Disposal	Activity For construction of the project facilities (paved streets, parking lots, and building rooftops) to reduce or eliminate pollutants in storm water runnoff (ADEC certifies APDES Stormwater CGPs)	FEED	x	x x	Date * Q3 2018	Data Needs 1. Stormwater Pollution Prevention Team 2. Site description 3. Site map 4. Summary of potential pollutant sources 5. Spill prevention and response procedures 6. Maintenance 7. Management and Physical Controls Best Management Practices (BMPs) 8. Erosion and sediment controls 9. Management of runoff 10. Employee training 11. Control measures 12. Monitoring 13. Inspections and documentation	Comments To obtain approval in the form of a letter of non-objection, an applicant must submit a short project description
Prevention of Significant Deterioration (PSD); ADEC Division of Air Quality	AKLNG		1.5-2 yr.; 3 years if site in or near non- attainment or Class I airshed.	Liquefaction Terminal				18 AAC 50.306; 18 AAC 50.316; 42 USC 7401 et seq.; AS 46.14 The resulting body of regulations is known as a State Implementation Plan (SIP).	to monitor air	x	x	x	Q2 2016	ADEC approval of a modeling protocol is necessary. PSD permits require significantly more analyses than Title V permits Typically, a long-range transport model is used to assess potential visibility issues. Data need for this model (AirMOD) must be approved by ADEC are: a. Ambient Air Quality (24 months); b. Meteorological Data (1 year). 3. An air quality related value (AORV) analysis is usually required to address sulfate and nitrate deposition, visibility, and potential growth impacts 4. Air Quality Control Plan	Must be obtained before beginning construction. A reconstruction monitoring plan may be required by ADEC and may require collecting one year of on-site ambient data. Additional requirements may apply.
Construction Permit for a Major Source of Hazardous Air Pollutant (HAP); ADEC, Division of Air Quality	AKLNG		3 years if site in or near non- attainment or Class I airshed.					18 AAC 50.306; 18 AAC 50.316; 42 USC 7401 et seq.; AS 46.14 The resulting body of regulations is known as a State Implementation Plan (SIP).	subject to a		x	x	Q1 2016		Application must be prepared and submitted per 40 CFR 63.5(d); ADEC will issue permit only if the criteria of 40 CFR 63.5(e)(1) are met.
Title V Operating Permit; ADEC, Division of Air Quality	AKLNG		no later than 12 months after the date on which the stationary source becomes subject to AS 46.14.120 (b).	Liquefaction Terminal	\$2,675	Annual		18 AAC 50; 40 CFR Part 71 AS 46.14.120 (b).	Authorizes owner/operator to construct new major stationary source; major modification; a project subject to the construction permitting requirements of 42 U.S.C. 7412(i)). Corresponds to every PSD Permit secured for construction.		x	х	Q2 2016	Map Plot plan Land Use Compatibility Statement, Process Flow Diagrams, Pollution Control Devises, Emission Summary, Regulatory Requirements	This is the operations permit applied before constructing, installing, modifying, or establishing a stationary source subject to AS 46.14.130 (a), Corresponds to every PSD Permit secured for construction.

Permit or Plan:	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	FEE D	EPC		Data Needs	Comments
General Conformity Determination; ADEC, Division of Air Quality	AKLNG			Liquefaction Terminal					A process required by the Clean Air Act (CAA), which establishes the framework for improving air quality to protect public health and the environment in a nonattainment or maintenance areas.		x		within time frame of SIP Q2 2016		FERC issues final GCD. Requires cooperation with ADEC on developing mitigation measures. FERC must issue prior to start of any project construction.
Approval to Construct and Operate a Public Water Supply System; ADEC, Division of Environmental Health	AKLNG/Camp Contractor		6-9 mo.	Liquefaction Terminal				18 AAC 72.200 ADEC approval under CWA Section 401	For construction of a public water system.			x	Q1 2018	Purpose and type of construction Facility Information Form Toriking Water Program – Project Information Form Engineering Plan Review Checklists Construction and Operations Plan required	ADEC must approve construction and operations of water treatment systems. Must have prior written approval of engineering plans that comply with 18 AAC 80.205.
Non-Domestic (Industrial) Wastewater Treatment System Plan Review, ADEC, Division of Water	AKLNG		Reviewed prior to construction; draft in EIS.	Liquefaction Terminal	NA	NA .			Required plan for disposal of wastewater from non-domestic wastewater sources are required as part of the application for a Wastewater Disposal Permit and an APDES Permit.			x	Q1 2016	Legal information Proposed project type Plan review Reports, drawings, and / or specifications	Approved in conjunction with Wastewater Disposal Permit and APDES Permit. Detailed engineering reports, plans and specifications must be certified by a registered professional engineer.

Permit or Plan:	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation		Pre- FEED	FEE D	EPC	Suggested Submittal Date^	Data Needs	Comments
Domestic and Non- Domestic Wastewater Disposal Permit (APDES); ADEC, Division of Water	AKLNG/Camp Contractor		1-2 mo.	Liquefaction Terminal	\$1480 see APDES General Permit	one time fee for constructio n activity		70 – Alaska Pollutant Discharge Elimination System	For disposal of wastewater from construction sites, waste water treatment facilities, underground injection, ballast water treatment facilities, etc. Domestic wastewater treatment facility (WWTF) required for any system that treats wastewater for disposal of water-borne human wastes or graywater from dwellings, commercial buildings, institutions, or similar structures.			x		Temporary Camp Practices Application Worksheet Anti-degradation Policy analysis Application of best management practices	Consolidated application for drinking water, food service, solid waste disposal, and domestic wastewater treatment and disposal for temporary camps.
UIC Waste Water Disposal; ADEC	AKLNG		Before injection activities	Liquefaction Terminal				AS 46.03; AAC; 72.010(a), 18 AAC; 72.215, and 18 AAC 72.500(a)	Permit for disposal of domestic or non- domestic wastewater.			x		ADEC General Permit Notice of Intent (GP 2010DB0001) to ADEC Copy of the EPA UIC authorization Description of project Injection flow rates and volume Location of well and information on receiving area.	

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Permit Matrix

Permit or Plan:	Contractor or Responsible Party*	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	FEE D	EPC	Suggested Submittal Date^	Data Needs	Comments
Open Burning Permit; ADEC – Air Permit Program	AKLNG/Contr actor	2-4 mo.	Liquefaction Terminal	NA NA	Annual			Potentially needed to dispose of woody debris during clearing and grubbing.			x		Develop an Open Burn Plan Location of all sensitive features How public will be informed Indicate coordination with concerned agencies Obtain weather forecasts and monitor changes Predicted smoke dispersion Enhancement of active fire phase and reduce the smoldering phase How to contact sensitive features Alternative disposal options Coordination with air quality authorities	Refer to ADEC Open Burning Policy and Guidelines, 2006. Open-burning of woody debris material by developers if the intent is to clear and burn 40 acres or more per year.
Open Burn Permits; ADNR, Division of Forestry	AKLNG/Contrr actor	30 day notice	Liquefaction Terminal	NA NA	Annual						x		Burn permits are required for some Division of Forestry offices – applications must be submitted for those units that require burn permits within the established fire seasons.	Check Alaska Wildland Fire Organization Administrative Units and Operational Centers status. Burn permits required during the fire season for all burning, with few exceptions.

Permit Matrix

Permit or Plan:	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	FEE D	EPC	Suggested Submittal Date^	Data Needs	Comments
Oversize and Overweight Permit; Alaska Department of Transportation and Public Facilities (ADOT&PF), Division of Measurement Standards & Commercial Vehicle Enforcement	AKLNG/Trucki ng Contractor		2-4 wk.	Liquefaction Terminal				17 AAC 25.310-380; AS 44.33.020; 03 AAC 35.120	For transport of oversize / oversize / overweight construction materials on ADOT&PF-owned roads.			x	Q3 2018	Orgin and exact route Overall length, overhangs, overall width, overall height Conditions Bridge condition attachment	Required for project activities that require the use of oversize/ overweight vehicles on public roads and highways.
State Temporary Land Use Permit (Uplands and Non- Marine Waters, Off Road Travel, and Tidal and Submerged Lands); ADNR, DMLW	AKLNG		1-6 months	Liquefaction Terminal	\$100			AS 38.05.850; 11 AAC 96; 11 AAC 58.210	For temporary project activities including access roads, camps, staging, and construction areas.			х	Q2 2018	Land Use Permit Application (102-1084A) including Supplemental Questionnaires Project Description General vicinity and site maps Duration and season Specific location, including proposed access routes Boundaries and dimensions of the proposed area and relation to geographic features Site description Description of toxic and hazardous materials, and hydrocarbons, types, volumes, storage location, and description of spill plan and methods Locations and dimensions of structures and storage areas Site access including mode of transportation	Geotechnical drilling would require a Temporary Land Use Permit. Individual LUPs can be issued during construction activities within 30 days. Temporary activities occurring on state lands, including activities in non-marine waters, uplands, off-road travel, and tidal and submerged lands.
Driveway/Approach Road Permit; Design and Engineering Services, ROW; ADOT&PF	AKLNG		2-3 mo.	Liquefaction Terminal				AS 19.05.20; 17 AAC 10.020 - 17 AAC 10.095)	For construction of access roads intersecting with a state road right-of-way.			х		Recorded subdivision plat Recorded subdivision plat Regineered drawings for approach road Site plan of subject property indicating location of proposed driveway, related parking arrangements and location of improvements Proof of ownership or lease agreement Traffic Impact Analysis Traffic Control Plan Red Cosure Permit Schedule of Operations Retainer fee	
Lane Closure Permit; Design and Englineering Services, ROW; ADOT&PF	AKLNG/Trucki ng Contractor		1-2 mo.	Liquefaction Terminal				17 AAC 20.017	For lane closures that may be necessary during construction activities.			х	Q3 2018	Applicant information Activity location Purpose of closure Start and end dates Schedule details Traffic Control Plan	Required for project activities that require the use of a highway ROW for access to or construction and maintenance of a utility facility. <i>May not be applicable</i>

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Permit or Plan:	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	FEE D	EPC	Suggested Submittal Date^	Data Needs	Comments
Highway Event; ADOT&PF	AKLNG/Trucki ng Contractor		1-2 mo.	Liquefaction Terminal				17 AAC 20	For transportation of material or construction work within state-owned highway ROW.			х	Q3 2018	Event description and number of participants Traffic Control Plan Sat and end dates Course map Froof of insurance Brochures or instructions to participants T. Letter of non-objection from impacted construction projects Written / verbal confirmation from law enforcement agency for traffic control Copies of advertisement proofs	To hold an event within state- owned highway ROW.
Building Plan Review Fire System Permit: Alaska Division of Fire and Life Safety (State Fire Marshall's Office)	AKLNG		2-4 mo.	Liquefaction Terminal				AS 18.70.080; 13 AAC 50.027; 13 AAC 50.035; 13 AAC 50.06 Compliance with applicable fire and building codes (13 AAC 50.020 Building Code; 13 AAC 50.025(30) Fire Code)	For building project facilities. To ensure fire systems meet state standards			x	Q3 2018	Plan Review application Plans and specifications of occupied facilities including electrical systems, mechanical systems, fuel storage tanks and their appurtenances, automatic fire-extinguishing systems.	Must be approved before work is started. Fire System Permit is required for the design, installation, testing, or maintenance of fire alarm signaling systems or automatic fire suppression systems, and for the ability to provide direct oversight and supervision of work being performed on the fire systems.
Utility Permits ROW; ADOT&PF	AKLNG		3 mo.	Liquefaction Terminal				17 AAC 15.010- .011, 17 AAC 15.021	For facilities crossing utility ROWs, new utility installations or the reconstruction or modification of existing facilities.			x	Q3 2018	1. Type of facility 2. Location of facility 3. Location of facility 4. Joint use (if applicable) 5. Facility construction plans and specifications (detailed) 6. A diagram or drawing showing the location of all known overhead, surface, and underground facilities existing in the vicinity of the proposed facility 7. Permit applications for pipeline installations must describe the nature of the substance to be transmitted; the maximum working, test, and design pressures; and the design standards for the pipe 8. Approval from applicable land owners/managers 9. Construction period	ADOT&PF has its own Environmental Program. 17 AAC 12.040 identifies its partial adoption of federal NEPA requirements 2. Additional requirements for section line utilities and encroachments May require additional permits for work in ROW
Encroachment Permit; ADOT&PF	AKLNG		3 mo,	Liquefaction Terminal				17 AAC 10.010 - 17 AAC 10.015, AS 19.05.010.	For crossing ADOT&PF highway ROW.			х	Q3 2018	Applicant information Proposed use of ROW Description of structure Size of proposed permit area Detailed site layout / site plan Required photographs Fee negotiation	Public notice is required. Required if pipeline is located near highways or within highway ROW.
								Le	ocal / Other Permi	ts & An	oroval	s S			
Solid Waste Disposal: KPB	AKLNG/Contr actor		3 mo.	Liquefaction Terminal				KPB Ordinance 10.04.060 10.04.070	Authorized for			x	Q3 2018	Coordination with the KPB Planning Commission to develop site-specific plans and protocols, locations.	Solid wastes authorized for disposition originating from industrial or commercial sources – permitted areas of origin; materials described

Permit Matrix

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Permit or Plan: Agency# Hazardous	Contractor or Responsible Party*	Contract Reference	Estimated Time for Permit Approval 3 mo.	Project Phase Liquefaction	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	FEE D	EPC X	Suggested Submittal Date^	Data Needs 1. Facility name and address;	Comments
nazardous Materials Reporting: KPB	actors		3 110.	Terminal				Б	For reporting hazardous materials, hazardous chemicals, hazardous wastes, or consumer commodities when certain quantities are handled.			x	Q3 20 10	1. Facility Italitie and address; 2. Owner/Operator name and address; 3. Emergency contact names and phone numbers; 4. EPA Hazardous Waste Number for each hazardous waste; 5. Characteristic for each hazardous waste (ignitable, reactive, corrosive or toxic); 6. Maximum daily and average daily quantities handled during the reporting period and number of days handled on-site; 7. Site layout and floor plan showing the usual and ordinary location of each hazardous waste.	Hazardous Materials Table at 49 CFR Part
Hazardous Materials Placarding: KPB	AKLNG/Trucki ng Contractor		3 mo.	Liquefaction Terminal				Page 3 of 14	Signage placed at facilities to give adequate warning to the public and to emergency response personnel of the type of hazardous materials, hazardous chemicals, or hazardous wastes handled.			x		The KPBOEM shall determine which numbers and symbols shall be contained on placards for facilities, based on the inventory reports submitted in accordance with this chapter.	Placards will be provided at no charge by the KPBOEM.
Right-of-way construction permits: KPB	AKLNG		3 mo.	Liquefaction Terminal					For construction of a road or driveway within a dedicated rights-of-way; regulate the flow of traffic			х		1. A statement of the length and width of right-of-way to be constructed, the proposed uses after construction, and a drawing on the plat of the location and proposed design and method of the construction; 2. Approximate locations of flood plain, floodways, wetlands, streams, lakes, or other water bodies adjacent to or within 50 feet of the outer boundaries of the right-of-way; 3. Approximate grades of the natural terrain and final grade of the proposed road; 4. Soil conditions of the area subject to construction; 5. Identification of all properties to be served or accessed by the proposed construction; 6. Amount, type and placement of materials used in construction	Permits for right-of-way work or new road construction may be obtained on-line or at the Road Service Area office, 47140 E. Poppy Lane, Soldotna. There are no applicable fees to obtain a right-of-way permit. http://www.borough.kenai.ak.us/images/KPB/R DS/ROW_Construction_Permit_Application.pd f

Permit or Plan	Party*	Contract Reference	Estimated Time for Permit Approval	Project Phase	Cost (Does Not Include Mitigation Fees)	Frequency of Permit	Total Cost per Installment	Statute / Regulation	Activity	Pre- FEED	EPC	Suggested Submittal Date^	Data Needs	Comments
Oversize and	AKLNG/Trucki		7 Days	Liquefaction				KPB Ordinance	For transportation		х	Q3 2018		Permit may be obtained from the road service
overweight permi	s: ng Contractor			Terminal				14.40.070-100	on Borough					area administrative office by filing an
KPB									roads;					application on a form provided by the borough.
									restrictions for				3. Weight, size - shall provide the gross weight, width, height, and number	
									vehicles and				of axles for each vehicle(s) or equipment which will be used.	
									equipment				4. Load classification - shall provide the classification of any material to be	
									exceeding the				hauled within the right-of-way as either agricultural, forestry, fishery, or other	
									gross weight, width and height				appropriate classification, if none of the foregoing is applicable. 5. Contact - shall provide the applicant's name, mailing address, physical	
									are set forth in 17				address, day and evening phone numbers, facsimile phone number, and	
									AAC 25.				secondary contact person.	
									7010 20.				Registration - shall provide a copy of the current vehicle registration and	
													vehicle license plate numbers.	
													7. Additional information - shall provide such other additional information as	
													the director or his/her designee deems necessary to ensure protection of	
													the right-of-way.	
													,	

Permit or Plan: Agency [#] Right-of-way use permits: KPB	Contractor or Responsible Party* AKLNG	Contract Reference	Estimated Time for Permit Approval 3 mo.	Project Phase Liquefaction Terminal	Cost (Does Not Include Mitigation Fees)	Frequency of Permit		Activity For ongoing maintenance of the right-of-way in a condition equal to that which existed before the permittee's operation began.	Pre- FEED	FEE D	EPC X		Data Needs The permittee shall repair the right-of-way immediately after discovery of any damage or deterioration caused by the permittee's use of the right-of-way.	Comments
Borough Lands and Resources: KPB	AKLNG			Liquefaction Terminal				For leasing KPB land (Short Term, long Term)			х		Development plan for the use, nature of improvements, estimate of value of the improvements, and a development and construction time table.	Application to lease must be submitted on a form provided by the land management division. Short term lease for a period not to exceed 5 years Long term lease of Borough lands for greater than 5 years.
Granting Right-of- way and easements: KPB	AKLNG		3 mo.	Liquefaction Terminal				Authority to Rights-of-way and easements across any borough lands			х	Q3 2018		The mayor is authorized to dedicate rights-of- way and grant easements across any borough lands upon receipt of application on the form provided by the land management division and payment of the appropriate fee.
Temporary Land Use Permit: KPB	AKLNG		30 days	Liquefaction Terminal				For temporary use of borough land			х	Q4 2018		Application form provided by the land management division and must be accompanied by the appropriate application fee. A temporary use permit is nontransferable and is valid for a period no greater than five years from the date of issue. May reissue a permit if the permittee has complied with the provisions of this section and the terms of the prior permit.

[#] Reference: FERC Resource Report 1, Appendix C

* AKLNG is not currently an agent nor the permittee. AKLNG is a placeholder for the Alaska LNG Project business entity under which permits will be obtained

^ Dates are suggested by the Pre-FEED Engineering Contractor; for internal awareness, the SSH&E Team will continue working with the LNG Team on the permitting schedule for LNG Plant construction and operations

List of Acronyms

AAC - Alaska Administrative Code

ADEC – Alaska Department of Environmental Conservation

ADF&G - Alaska Department of Fish and Game ADNR - Alaska Department of Natural Resources

ADOT&PF - Alaska Department of Transportation and Public Facilities

AHRS - Alaska Heritage Resources Survey

ANGPA - Alaska Natural Gas Pipeline Act

ANILCA- Alaska National Interest Lands Conservation Act

AOGCC - Alaska Oil and Gas Conservation Commission

APDES - Alaska Pollutant Discharge Elimination System

AQRV - Air Quality Related Value

AS - Alaska Statute

BGEPA – Bald and Golden Eagle Protection Act

BIA - Bureau of Indian Affairs

BLM - Bureau of Land Management

CGP - Construction General Permit

CHA - Critical Habitat Area

CFR - Code of Federal Regulation

CPCN - Certificate of Public Convenience and Necessity

CUP - Conditional Use Permit

CWA - Clean Water Act

DEIS - Draft Environmental Impact Statement

DMLW - Alaska Department of Natural Resources, Division of Mining, Land, and Water

DOE - Department of Energy

EFH - Essential Fish Habitat

EIS – Environmental Impact Statement

EO - Executive Order

EPA - U.S. Environmental Protection Agency

ERL - Environmental, Regulatory and Lands

ESA - Endangered Species Act

FAA - Federal Aviation Administration

FCC - Federal Communications Commission

FERC - Federal Energy Regulatory Commission

FONSI – Finding of No Significant Impact

GCD - General Conformity Determination

GP - General Permit

G&PA - Government and Public Administration

GTP - Gas Treatment Plant

HAP - Hazardous Air Pollutant

HDD - Horizontal directional drilling

HIA - Health Impact Assessment

HMR - Hazardous Materials Regulations

IHA - Incidental Harassment Authorization

IHLC - Inupiat History, Language, and Culture

KPB - Kenai Peninsula Borough

KPBOEM - KPB Office of Emergency Management

LOA - Letter of Authorization

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List of Acronyms

LOR - Letter of Recommendation

LNG - Liquefied Natural Gas

LUP - Land Use Permit

MBTA - Migratory Bird Treaty Act

MMPA - Marine Mammal Protection Act

MPRSA - Marine Protection Research and

NEPA - National Environmental Policy Act

NGA - Natural Gas Act

NHPA - National Historic Preservation Act

NMFS - National Marine Fisheries Service

NOAA – National Oceanic and Atmospheric Administration

NOI - Notice of Intent

NPDES - National Pollutant Discharge Elimination System

NRHP - National Register of Historic Places

NTP - Notice to Proceed

NVIC - Navigation and Vessel Inspection Circular

OHA - Alaska Department of Natural Resources, Office of History & Archaeology

PHMSA – Pipeline and Hazardous Materials Safety Administration

PA - Programmatic Agreement

POD - Plan of Development

PSD – Prevention of Significant Deterioration

RCA - Regulatory Commission of Alaska

RCRA - Resource Conservation and Recovery Act

ROE - Right-of-Entry

ROD - Record of Decision

ROW - Right-of-Way

Sanctuaries Act

SDWA - Safe Drinking Water Act

SGR - State Game Refuge

SHPO - State Historic Preservation Officer

SIC - Standard Industrial Classification

SIP - State Implementation Plan

SPCC - Spill Prevention, Control, and Countermeasure

SWPPP - Stormwater Pollution Prevention Plan

UIC - Underground Injection Control

USACE - U.S. Army Corps of Engineers

USC - United States Code

USCG - U.S. Coast Guard

USDOI - U.S. Department of the Interior

USDOT - U.S. Department of Transportation

USDW - Underground Sources of Drinking Water USFS - U.S. Forest Service

USFWS - U.S. Fish and Wildlife Service

WQS - Water Quality Standards

WSA - Waterway Suitability Assessment

WWTF - Wastewater Treatment Facility



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C.2 – Regulatory Agency Correspondence

Document Number:	Description:	Revision:	Appendix:
N/A	Refer to Resource Report 1 and Resource Report 11	N/A	Public



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APPENDIX COVERSHEET

C.3 – Regulatory Compliance Matrix

Document Number:	Description:	Revision:	Appendix:
USAI-PE-SRREG-00-000011-000	Demonstration of Code Compliance	0	Public



DEMONSTRATION OF CODE COMPLIANCE

USAL-EX-SPREG-00-000001-000



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	LE 3.0-1 Code Compliance for NFPA 59A (2006)	



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1.0 49 CFR PART 193 REGULATORY COMPLIANCE

Table 1 lists the sections of 49 CFR Part 193 and the reference in Resource Report 13 where each of the following requirements is discussed. Additional references are included below.

193.2051 - Scope

The Facility falls within the scope outlined in this paragraph. It will be sited in accordance with the criteria set forth in Subpart B – Siting Requirements.

193.2119 - Records

During the design and construction of the Facility, records of all materials for components, buildings, foundations and support systems will be maintained. The operator will keep these records for the life of the item concerned.

193.2155 – Structural Requirements

The LNG storage tanks will not be located within a horizontal distance of one mile from the ends, or 0.25 mile from the nearest point of an airport runway, whichever is longer.

193.2187 - Nonmetallic Membrane Liner

The LNG storage tanks will not use a flammable non-metallic membrane liner.

193.2301 - Scope

The Facility will comply with the requirements of this Part and NFPA 59A. In the event of a conflict between this Part and NFPA 59A, this Part shall prevail.

193.2303 - Construction Acceptance

New construction on the Facility will not be placed in service until it passes all applicable inspections and tests prescribed in this subpart and NFPA 59A.

193.2304 - Corrosion Control Overview

Materials for new components of the Facility will be reviewed from a corrosion control viewpoint to verify that the materials selected will not impair the safety and reliability of the component. While in service, the 9% Ni steel liquid container of the LNG storage tank is not subject to corrosion since it will operate at cryogenic temperatures in a non-corrosive atmosphere.

193.2321 - Nondestructive Tests

The required radiographic testing methods will be used as defined by this section and by using written procedures that describe techniques, reporting and record keeping.

193.2401 - Scope



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Liquefaction equipment and control systems have been designed and will be fabricated and installed in accordance with the requirements of this Part and NFPA 59A. In the event of a conflict between this Part and NFPA 59A, this Part prevails.

Subpart F - Operations

193.2503 - Operating Procedures

Operating procedures will be prepared and extensive training will be provided so that Facility personnel are familiar with and understand the importance of adherence to safe procedures. These procedures will address safe start-up, shutdown, cooldown and purging as well as routine and abnormal operation and monitoring.

193.2507 – Monitoring Operations

The control center design will facilitate compliance with applicable requirements of Part 193 with regard to Facility operations.

193.2511 - Personnel Safety

Protective clothing and equipment necessary for the safety of personnel while performing emergency response duties will be provided. First-aid materials will be provided in a clearly marked location available to all personnel. Multiple escape points from potential thermal radiation hazards for pool fires are provided throughout the Facility.

193.2519 - Communication Systems

A primary communication system providing verbal communications between all operating personnel at their work stations will be provided.

An emergency communication system providing verbal communications between all persons and locations necessary for the orderly shutdown of operating equipment and the operation of safety equipment in time of emergency will be provided.

193.2521 - Operating Records

Inspection, testing and investigation records required by Part 193, subpart F and NFPA 59A will be maintained for a period of not less than five years.

Subpart G – Maintenance

The operator will follow one or more manual(s) of written procedures for maintenance of each component. Particular care will be taken to address replacement of equipment parts or systems with like components that are suitable for the intended service. These procedures will be coordinated with the operating procedures to make sure that operation of equipment is in compliance with proper procedures. Fire protection, air compressor and auxiliary power systems will be tested periodically to insure that these systems are in a fully operable state should they be required. There are no LNG transfer hoses in the design.

193.2623 - Inspecting LNG Storage Tanks



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Inspection and/or applicable testing of the LNG tanks to verify the structural integrity and safety of the tank will be performed after any major meteorological or geophysical disturbance.

193.2625 - Corrosion Protection

There will be periodic testing of the installed cathodic protection systems by a person specifically trained for this type of work.

193.2619 - Control Systems

Control systems and their components will be inspected and tested at a frequency not exceeding fifteen months. The fire protection control system will be inspected at least once every six months.

193.2639 - Maintenance Records

Maintenance records, including periodic inspections and tests, required to comply with Part 193 or NFPA 59A will be maintained for a period of not less than five years.

Subpart H - Personnel Qualifications and Training

An engineering, procurement and construction contractor qualified and experienced in the design and construction of the Facility will be employed to design, procure and construct the Facility.

For operations and maintenance, all personnel assigned to the Facility will be properly trained and determined to be qualified to perform their duties. Training records providing evidence that all personnel have undergone and satisfactorily completed required training will be maintained for one year after personnel are no longer assigned duties for the Facility.

Subpart J – Security

The Facility will comply with all applicable requirements of this subpart. Procedures and systems will be developed to complement these design features.



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	TABLE 1.0-1	
	Code Compliance for 49 CFR	193
Section No.	Requirement	Location of Compliance in RR13
	Subpart A	
193.2001	Scope of part	Not Applicable
193.2005	Applicability	Not Applicable
193.2007	Definitions	Not Applicable
193.2009	Rules of regulatory construction	Not Applicable
193.2011	Reporting	Owner will make provisions to comply with requirement.
193.2013	Incorporation by reference	Not Applicable
193.2017	Plans and procedures	Throughout RR13
193.2019	Mobile and temporary LNG facilities	Not Applicable
	Subpart B	
193.2057	Thermal radiation protection	Appendix Q.1, Resource Report 11.5
193.2059	Flammable vapor-gas dispersion protection	Appendix Q.1, Resource Report 11.5
193.2067	Wind forces	13.4.5, 13.6.1
	Subpart C	
193.2119	Records	Owner will make provisions to comply with requirement.
193.2155	Structural requirements	13.6, 13.13
193.2161	Dikes, general	13.1.18, 13.6.1
193.2167	Covered systems	Not Applicable
193.2173	Water removal	13.1.18, 13.7.4, 13.13.1
193.2181	Impoundment capacity: LNG storage tanks	13.6, 13.13, Appendix Q.1
193.2187	Nonmetallic membrane liner	Not used
	Subpart D	
193.2303	Construction acceptance	The Owner will make provisions to meet requirement.
193.2304	Corrosion control overview	The Owner will develop construction, maintenance and repair procedures meeting this requirement.
193.2321	Nondestructive tests	13.6, Appendix L.1
	Subpart E	1
193.2441	Control center	13.1.19, 13.9, 13.10, 13.14.1, 13.19, 13.22, Appendices P.1, U.1, U.13
193.2445	Sources of power	13.4.26, 13.9.5, 13.9.7, 13.11, Appendices U.1, O
	Subpart F	
193.2503	Operating procedures	13.1.23
193.2505	Cooldown	13.1.22
193.2507	Monitoring operations	13.9, 13.10, 13.14, Appendices U.12, U.7, U.11, N.1, N.2
193.2509	Emergency procedures	13.15 and Appendix P.2



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	TABLE 1.0-1	
	Code Compliance for 49 CFR	193
Section No.	Requirement	Location of Compliance in RR13
193.2511	Personnel safety	Owner will make provisions to meet requirement.
193.2513	Transfer procedures	Owner will make provisions to meet requirement.
193.2515	Investigations of failures	Owner will make provisions to meet requirement.
193.2517	Purging	Owner will make provisions to meet requirement.
193.2519	Communication systems	13.1.23, 13.15, 13.19, Appendix C.19
193.2521	Operating records	Owner will make provisions to meet requirement.
	Subpart G	
193.2603	General	Owner will make provisions to meet requirement.
193.2605	Maintenance procedures	Owner will make provisions to meet requirement.
193.2607	Foreign material	Owner will make provisions to meet requirement.
193.2609	Support systems	Owner will make provisions to meet requirement.
193.2611	Fire protection	Owner will make provisions to meet requirement.
193.2613	Auxiliary power sources	Owner will make provisions to meet requirement.
193.2615	Isolating and purging	13.1.17, 13.1.23.1, 13.7.2, 13.11.3.6
193.2617	Repairs	Owner will make provisions to meet requirement.
193.2619	Control systems	Owner will make provisions to meet requirement.
193.2621	Testing transfer hoses	13.1.23 Owner will make provisions to meet requirement.
193.2623	Inspecting LNG storage tanks	13.6, Appendix L
193.2625	Corrosion protection	Owner will make provisions to meet requirement.
193.2627	Atmospheric corrosion control	Appendix C
193.2629	External corrosion control: buried or submerged	13.11.1, Appendix T.1
193.2631	Internal corrosion control	13.5.3, 13.6, Appendices L.1, T.1
193.2633	Interference currents	13.11.1
193.2635	Monitoring corrosion control	13.1.23
193.2637	Remedial measures	13.1.23
193.2639	Maintenance records	13.1.23
	Subpart H	
193.2703	Design and fabrication	Owner will make provisions to meet requirement.
193.2705	Construction, installation, inspection, and testing	13.1.23 Owner will also make provisions to meet other requirements.
193.2707	Operations and maintenance	Owner will also make provisions to meet requirements.
193.2709	Security	13.19, Appendix U.13
193.2711	Personnel health	Owner will make provisions to meet requirement.
193.2713	Training: operations and maintenance	13.1.23
193.2715	Training: security	13.19
193.2717	Training: fire protection	13.1.23, Appendix P.2



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	TABLE 1.0-1				
	Code Compliance for 49 CFR 193				
Section No.	Requirement	Location of Compliance in RR13			
193.2719	Training: records	13.1.23			
	Subpart I				
193.2801	Fire Protection	Appendix P.1			
	Subpart J				
193.2903	Security procedures	13.19,			
		Appendix U.13			
193.2905	Protective enclosures	13.19,			
		Appendix U.1, U.13			
193.2907	Protective enclosure construction	13.19,			
		Appendix U.13			
193.2909	Security communications	13.19,			
		Appendix U.13			
193.2911	Security lighting	13.19,			
		Appendix U.13			
193.2913	Security monitoring	Appendix U.13			
193.2915	Alternative power sources	13.9.4, 13.9.5, 13.11.1,			
		Appendix O.2, U.13			
193.2917	Warning signs	Appendix U.13			



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2.0 NFPA 59A 2001 REGULATORY COMPLIANCE

Table 2 lists the sections of NFPA 59A (2001 edition) and the reference in Resource Report 13 where each of the following requirements is discussed. Additional references are included below.

2.4 Designer and Fabricator Competence

Designers, fabricators and constructors will be experienced, competent and properly trained. A soils investigation has been initiated for the site. Proper supervision will be provided for the fabrication, construction and acceptance tests for the Facility components.

2.5 Soil Protection for Cryogenic Equipment

The LNG storage tank foundations will not be in direct contact with soils and therefore no heating system will be required to prevent frost heave from occurring. In addition, no cryogenic equipment or piping will be in direct contact with soils.

2.6 Falling Ice and Snow

Safety measures and procedures will be developed to protect personnel and equipment from accumulated snow and ice.

2.7 Concrete Materials

Concrete used in the construction of LNG tanks will be in accordance with Section 4.3 of NFPA 59A. Other than possibly the LNG tanks, there are no concrete structures that will normally be in contact with LNG. Pipe supports will be in accordance with Section 6.4 of NFPA 59A. Concrete for slope protection and impounding area paving will comply with ACI 304R. Reinforcement will comply with Paragraph 2.2.1 of ACI 344R-W.

3.1 Process Systems - General

Much of the process system equipment containing LNG, flammable refrigerants or flammable gases is located outdoors. Equipment that is located inside buildings or structural enclosures will comply with Sections 2.3.1, 2.3.2 and 2.3.3 of NFPA 59A.

3.2 Pumps and Compressors

All pumps and compressors will meet the requirements of this paragraph.

3.3 Flammable Refrigerant and Flammable Liquid Storage

Installations of storage tanks for flammable liquids will comply with all of the standards noted in paragraph 3.3 of NFPA 59A.

3.4 Process Equipment

All process equipment has been designed to meet the requirements of this section. Equipment, piping and process vessels subject to a vacuum are designed to withstand vacuum conditions and provisions are made to prevent the development of a vacuum in equipment that might create a hazardous condition.



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4.1 Stationary LNG Storage Containers - General

The LNG storage tanks will be inspected to insure compliance with the engineering design and material, fabrication, assembly and test provisions of NFPA 59A prior to the initial operation of the Facility.

4.2 Metal Containers

The design pressure of the LNG storage tanks is 4.2 psig (less than 15 psig). Radiographic inspection of welds will be performed in accordance with paragraph 4.2.1.

4.3 Concrete Containers

The concrete outer container of the LNG storage tanks will be in accordance with ACI 318, ACI 376 and the provisions of 4.3.2.2 through 4.3.2.5 of NFPA 59A.

4.4 Marking of LNG Containers

The LNG storage tanks will have a nameplate with all the information required by this section. Each penetration will be marked with the function of the penetration and the mark will be visible if frosting occurs.

4.6 Container Purging and Cooldown

The LNG storage tanks will be purged and cooled down in accordance with Sections 11.3.5 and 11.3.6 of NFPA 59A prior to placing the LNG storage tanks into service.

4.7 Relief Devices

Pressure and vacuum relief devices for the LNG storage tanks will be in accordance with Section 4.7 of NFPA 59A.

5.6 Products of Combustion

The Facility has no vaporizers installed in buildings.

6.1 Piping Systems and Components - General

All piping systems will be in accordance with ASME B31.3 except where other codes will govern. During detailed design, all piping will be designed for the seismic loads and resulting stresses. The piping systems and their design will take into account fatigue effects. Expansion and contraction of the piping systems will be taken into account during detailed design of the supports and layout of the piping systems.

6.2 Materials of Construction

All materials of construction will be compatible with the design temperatures. The piping systems design will meet the requirements of 6.2.1.2. The insulating system to be installed will not propagate fire and will maintain its properties during an emergency. Where applicable, ASTM A312 type 304 or 304L stainless steel, or Invar alloy pipe will be used for cryogenic or corrosive fluid services. The piping systems will comply with ASME B31.3. Valves will comply with the requirements of section 6.2.4.

6.3 Installation



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The piping connection requirements of paragraph 6.3.1 and 6.3.2 will be incorporated into the piping design and into the specifications that govern welding, fabrication and erection of the piping system. Valves exposed to cryogenic temperatures will be provided with extended bonnets. All penetrations conveying fluids to or from the LNG storage tanks will be provided with shutoff valves at the tank. Pipe welding procedures and welders will be qualified in accordance with ASME B31.3, Section IX of the ASME Boiler and Pressure Vessel Code and meet the requirements of 6.3.4. The pipe marking requirements of 6.3.5 will be included in the fabrication and construction process.

6.3.2.3

A bulkhead, or transition piece, is strategically placed in order to allow the Pipe-in-Pipe (PiP) system to transition both to and from another piping system that uses other materials to restrain the potential thermal expansion between the two systems. The Facility will use the bulkheads to transition between conventionally insulated 304 SS piping and Invar PiP.

6.4 Pipe Supports

Pipe supports that prevent excessive icing or embrittlement of the support steel will be utilized. Low temperature piping will not rest directly on structural supports.

6.5 Piping Identification

Piping will be uniquely identified by color coding, labelling or painting per the requirements of this section.

6.6 Inspection and Testing of Piping

Written procedures will be prepared to incorporate the requirements of Section 6.6 for the testing of piping. Radiographic and other nondestructive testing methods will be used as required under Section 6.6.3, using written procedures that describe technique, report and record keeping.

6.7 Purging of Piping Systems

LNG and natural gas lines will be installed with purge points so that the lines can be purged with nitrogen.

6.8 Safety and Relief Valves

All piping where overpressure is possible, will be protected by safety relief valves set to keep the internal pressure on the piping within its design limits. The discharge from these relief valves will be directed to the flare system, except for the LNG storage tank relief valves and thermal relief valves.

6.9 Corrosion Control

Piping that will be run underground, such as drainage and firewater piping, will either be constructed of corrosion-resistant materials or be coated and protected by cathodic protection where required. Piping components will be periodically inspected and repaired or replaced if necessary under the scheduled maintenance program established in the maintenance procedures and NACE RP 0169.

7.7 Electrical Grounding and Bonding

An electrical grounding grid will be provided for the LNG storage tanks and will be interconnected with other facilities. Ground rods will be used as required to connect the grid to earth potential. Bonding of the grid to the equipment will use cad weld connections or grounding lugs as required. The grid will use copper



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stranded wire and will be buried between connections to equipment. The grounding grid will eliminate stray currents. Lightning protection will be provided for the LNG storage tanks and other facilities where applicable.

8.2 Piping System

Isolation valves will be installed at the extremities of each transfer system. Hydraulic shock analysis will be performed on all lines which contain an automatic shutoff valve. Check valves will be provided at points in which backflow may occur.

8.3 Pump and Compressor Control

Pumps and compressors transferring LNG or refrigerants will be capable of being shut down both locally and remotely from the control rooms, and will have signal lights to indicate when pumps and compressors are operating or idle.

8.4 Marine Shipping and Receiving

The Terminal's ship unloading and mechanical systems will be in accordance with this Section 8.4 of NFPA 59A.

8.5 Tank Vehicle and Tank Car Loading and Unloading Facilities

Not applicable.

8.8 Communications and Lighting

Adequate communications will be provided to allow the operator at the loading operation to be in contact with other personnel associated with the loading operation.

9.6 Maintenance of Fire Protection Equipment

The Facility maintenance procedures will incorporate routine maintenance for fire protection equipment per NFPA 10 and other applicable codes and standards.

9.7 Personnel Safety

Emergency procedures will be developed, which will include the protective clothing to be worn and procedures for confined space entry. At least three portable flammable gas detectors will be readily available.

9.9 Other Operations

Manual emergency depressuring of flammable or hazardous fluids will normally be accomplished by hard piped connections to the Facility flare system.

Chapter 10 – Alternate Requirements for Stationary Applications Using ASME Containers

There will be no LNG storage tanks with a volume of less than 100,000 gallons designed in accordance with the ASME Boiler and Pressure Vessel Code.

Chapter 11 - Operating, Maintenance, and Personnel Training



APPENDIX F.1 – DEMONSTRATION OF CODE
COMPLIANCE

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Operating, maintenance, and training procedures will be developed per the requirements of this section. These written procedures will incorporate the requirements of NFPA 59A and other applicable codes and regulations and will be used to train and qualify all operations personnel before commissioning and operation.



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	TABLE 2.0-1	
	Code Compliance for NFPA 59A (20	001)
Section No.	Requirement	Location of Compliance in RR13
CHAI	PTER 1 GENERAL	
1.1	Scope	Not Applicable
1.2	Equivalency	Not Applicable
1.3	Retroactivity	Not Applicable
1.4	Training of Personnel	13.1.23
1.5	Metric Practices	Not Applicable
1.6	Referenced Standards	Not Applicable
1.7	Definitions	Not Applicable
CHAPTER 2	PLANT SITING AND LAYOUT	· ·
2.1	Plant Site Provisions	13.3, 13.4,
		Appendices C, G, I, J, P.1, U.1, U.16
2.2	Major Site Provisions for Spill and Leak Control	13.3, 13.6, 13.7.4.2, Appendices L.1, Q.1, Q.2, U.1, U.16
2.3	Buildings and Structures	13.22,
		Appendix U.1, U.7
2.4	Designer and Fabricator Competence	Owner will make provisions to meet othe requirements
2.5	Soil Protection for Cryogenic Equipment	13.6, 13.21,
		Appendix L.1, J
2.6	Falling Ice and Snow	Appendices U.7, U.8
2.7	Concrete Materials	13.3.1, 13.6, 13.13, 13.21, Appendix T.4
CHAPTER 3	3 PROCESS EQUIPMENT	
3.1	General	13.5, Appendix U.1
3.2	General	13.5, Appendices C, U.4
3.3	Flammable Refrigerant and Flammable Liquid Storage	13.5.4, 13.6,
3.4	Process Equipment	Appendices C, L 13.3, 13.4, 13.5, 13.6, 13.7, 13.13,
3.4	Process Equipment	Appendices D.1, L.1, Q.1, Q.2, U.1, U.1
CHAPTER 4 STATIO	DNARY LNG STORAGE CONTAINERS	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
4.1	General	13.4, 13.6, 13.21,
	Scholar	Appendices I, J, L
4.2	Metal Containers	13.6,
		Appendices C, L, M
4.3	Concrete Containers	13.6, 13.21,
		Appendix L
4.4	Marking of LNG Containers	Owner will comply
4.5	Testing of LNG Containers	13.6
4.6	Container Purging and Cooldown	13.5, 13.6, 13.1.22
4.7	Relief Devices	13.6.13, Appendices L.1, L.5
CHAPTER 5 -	- VAPORIZATION FACILITIES	
5.1	Classification of Vaporizers	13.5, Appendix M.1



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	TABLE 2.0-1	
	Code Compliance for NFPA 59A (2007)	1)
Section No.	Requirement	Location of Compliance in RR13
5.2	Design and Materials of Construction	13.5, Appendices D.1, M.1, U.4
5.3	Vaporizer Piping and Intermediate Fluid Piping and Storage	13.5, Appendices D.1, M.1, U.4
5.4	Relief Devices on Vaporizers	13.5, Appendices D.1, M.1, U.4
5.5	Combustion Air Supply	13.5, AppendicesU.1, U.4
5.6	Products of Combustion	13.5, Appendices U.1, U.4
CHAPTER 6 PIPIN	IG SYSTEMS AND COMPONENTS	
6.1	General	13.20, Appendices C, T.1, U.16
6.2	Materials of Construction	13.20, Appendices C, T.1, T.2
6.3	Installation	13.20, Appendices C, T.1
6.4	Pipe Supports	13.20, Appendix U.16
6.5	Piping Identification	13.20, Appendices C, T.1, U.4
6.6	Inspection and Testing of Piping	13.20, Appendices C, T.1
6.7	Purging of Piping Systems	13.1.17, 13.7.2, Appendix C
6.8	Safety and Relief Valves	Appendices C, U.4
6.9	Corrosion Control	Appendices C, T.1
HAPTER 7 INSTRUME	NTATION AND ELECTRICAL SERVICES	
7.1	Liquid Level Gauging	13.6.6, 13.15, Appendices L, U.4
7.2	Pressure Gauge	13.6.7, 13.15, Appendices L, U.4
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7.5	Emergency Shutdown	13.10.5, Appendices C, U.1
7.6	Electrical Equipment	13.20, Appendices M, O.2, O.3
7.7	Electrical Grounding and Bonding	13.20.1
CHAPTER 8 TRANS	SFER OF LNG AND REFRIGERANTS	
8.2	Piping System	13.20, Appendices C and U.4
8.3	Pump and Compressor Control	13.10, Appendix U.4



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	TABLE 2.0-1	
Section No.	Code Compliance for NFPA 59A (20 Requirement	Location of Compliance in RR13
	•	-
8.4	Marine Shipping and Receiving	13.5.2 Appendix C, U.4
8.5	Tank Vehicle and Tank Car Loading and Unloading Facilities	Not Applicable
8.6	Pipeline Shipping and Receiving	Not Applicable
8.7	Hoses and Arms	13.5, Appendices C and U.4
8.8	Communications and Lighting	13.19, Appendix U.13
CHAPTER 9 FIRE PRO	OTECTION, SAFETY, AND SECURITY	
9.1	General	13.16, 13.17, Appendix P.1, P.3, U.10, U.11, U.12
9.2	Emergency Shutdown Systems	13.10, Appendices N.1, N.2, U.4, S.1
9.3	Fire and Leak Control	13.14, Appendices M.4, P.1, U.10, U.11, U.12
9.4	Fire Protection Water Systems	13.17, Appendices U.2, P.1, P.3, M.4, M.5, U.4
9.5	Fire Extinguishing and Other Fire Control Equipment	13.15, 13.16, 13.17, 13.18, Appendices U.2, P.1, P.3, M.4, M.5, U.4
9.6	Maintenance of Fire Protection Equipment	13.1.23
9.7	Personnel Safety	13.1.23
9.8	Security	13.1.23
9.9	Other Operations	13.24, Appendices C, U.4
	TE REQUIREMENTS FOR STATIONARY USING ASME CONTAINERS	Not Applicable
CHAPTER 11 OPERATII	NG, MAINTENANCE, AND PERSONNEL TRAINING	
11.1	General	13.1.23
11.2	Basic Requirements	13.1.23, 13.15, Appendices P.1, H.1
11.3	Documentation of Operating Procedures	13.1.22,13.1.23, 13.15, Appendices C, H.1
11.4	Marine Shipping and Receiving	13.1.23
11.5	Maintenance	13.1.23, Appendix C
11.6	Training	13.1.23, Appendix H.1



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3.0 NFPA 59A 2006 REGULATORY COMPLIANCE

Table 3 lists the sections of NFPA 59A (2006 edition) and the reference in Resource Report 13 where each requirement is discussed. Additional references are included below.

7.2.2 Seismic Design of Field-Fabricated Containers

A site-specific seismic hazard evaluation for the Facility has been completed and a seismic design basis has been prepared for the facilities.

7.3.1.2 API 620, Appendix Q

The LNG Facility storage tanks will be designed in compliance with API 620, Appendix Q, along with other applicable design codes, including NFPA 59A-2001/2006 and ACI 318 and ACI 376.

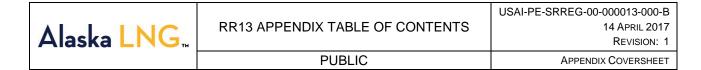


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	TABLE 3.0-1		
Code Compliance for NFPA 59A (2006)			
Section No.	Requirement	Location of Compliance in RR13	
7.2.2	Seismic Design of Field-Fabricated Containers	13.4.4, 13.6.2, 13.6.11, Appendix I	
7.3.1.2	API 620, Appendix Q	13.1.16, 13.6	



APPENDIX 13D - CODES AND STANDARDS

D.1 – List of Codes and Standards

Document Number:	Description:	Revision:	Appendix:
USAL-CB-BSCOD-00-000001-000	Engineering Codes and Standards List	2	Public
AKLNG-4030-VVV-SPC-DOC-00001	EPC Contractor Codes and Standards List	0	Public

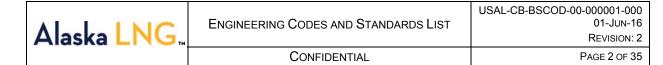
Alaska LNG



ENGINEERING CODES AND STANDARDS LIST

USAL-CB-BSCOD-00-00001-000

Rev		Date	Revision	Description	Originato Checke		Reviewer / Endorser	Respo Cod	202	Ap	prover	
0	0 22-Jan-16 Issued for FEED		0 22-Jan-16		EED	D. Verell / Kitayama	202	M. Evans	2		M.	Suzuki
1	25-,	Jan-16	Issued for FI	EED	D. Verell / Kitayama		S. O'Brien	2		M.	Suzuki	
2	01	Jun-16	Issued for Fi	EED	R.Bernal T.Kitayan		ŋ			M.	Suzuki	
Document Control No.		Country	Facility	Originator	Discipline	Туре	Sub- Type	Location	Sequ	ence	Identifier	
		US	AL	CB	В	S	COD	00	0000	001	000	



REVISION MODIFICATION LOG

Revision	Section	Description		
1	3.0	Addition of four (4) regulations.		
2	3.0, Table 1	 Added the following codes and standards: a. ACI-209R-92 – Prediction of Creep, Shrinkage, and Temperature Effects in Concrete Structures b. ASCE 7-10 – Minimum Design Loads for Buildings and Other Structures c. ASCE 37-02 – Design Loads on Structures During Construction d. ASCE41-13 – Seismic Evaluation and Retrofit of Existing Buildings (Equation 2-11) e. AWWA D110A-13 – Wire-and Strand-Wound Circular, Prestressed Concrete Water Tanks f. Federal Emergency Management Agency 440 2005 – Improvement of Nonlinear Static Analysis Procedure- 		



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3.0	SPEC	CIFIC INDUSTRY CODES AND STANDARDS	6
		LIST OF TABLES	
Table	1: App	licable Codes and Standards	6

Alaska LNG	Engineering Codes and Standards List	USAL-CB-BSCOD-00-000001-000 01-Jun-16 REVISION: 2
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1.0 INTRODUCTION

1.1 Purpose

Engineering systems and equipment for the AKLNG Pre-FEED Project shall be designed, fabricated and installed in accordance with the applicable editions of U.S. Federal, State and Local Codes and Standards. International Codes and Standards are generally not applicable unless approved by AKLNG. This list of applicable Codes and Standards has been prepared for the Pre-FEED Phase of the project and will be further developed during subsequent phases of the project.

1.2 SCOPE

A standard consists of technical definitions and guidelines that function as instructions for designers, manufacturers, users and operators of equipment. Applicable standards for the AKLNG Liquefaction Facility Project are listed in Table 1.

Standards created by the organizations in Table 1 are referenced for use by engineering, manufacturing, construction and the end user. Table 1 also includes the specific codes and standards referenced in AKLNG Lead Technical Party Standards.

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2.0 GENERAL

2.1 APPLICATION OF CODES AND STANDARDS

Documents listed in Table 1 include the codes and standards applicable to engineering work. Referenced codes and standards that may be referenced within the body of the codes and standards included in Table 1, but not separately listed in Table 1, shall be complied with as applicable. Written approval by AKLNG is required prior to any deviation from the codes and standards listed in Table 1.

Where requirements contained in the project specifications are more stringent than those in the referenced codes and standards, the specification shall govern.

Applications of codes and standards shall also include any Errata/Addenda/Appendix/Changes and reaffirmed (Year) published for the applicable code or standard. If clarification or interpretation is required for a clause in a code or a standard; the Technical Code Committee member or Secretary of the Standards Council can be contacted.

Table 1 is divided in two columns indicating the document number (identifies parent organization) and the document title (description). Unless noted otherwise in Table 1, the current edition or publication year (available in 2015) is used for each code and standard listed for the AKLNG Pre-FEED phase of the project, except where required by federal, state and local regulations. In the event that regulations require differing edition years, AKLNG will interface with the agencies and agree on which version to follow. Applicable editions of the codes and standards may change during the FEED and EPC phases as determined by AKLNG.

It is important to note that some of the standards are applicable to multiple types of equipment, applications and installations. For example NEMA ICS 4, Standard on Terminal Blocks is applicable to various types of equipment such as packaged equipment, power distribution centers, and switchgear.

Generally, engineering bulk materials and equipment shall be approved by and bear the label of Underwriter's Laboratory (UL) or Factory Mutual (FM) for application in the specified service conditions and hazardous area classified locations. When UL or FM approval does not exist; the Seller shall produce documentation for approval by AKLNG to show that the equipment meets or exceeds requirements of the applicable codes and standards. AKLNG may seek approval for such equipment on a case-by-case basis from the Authority Having Jurisdiction.

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3.0 SPECIFIC INDUSTRY CODES AND STANDARDS

The design, equipment and installation shall be in accordance with the applicable federal, state and local codes and standards for AKLNG Project.

Table 1: Applicable Codes and Standards

<u>Standard</u>	Description
Code of Federal Regulation (
14-CFR-Part 77	Objects Affecting Navigable Airspace
18-CFR-Part 153	Applications for Authorization to construct, Operate, or Modify Facilities used for the Export or Import of Natural Gas
18-CFR-Part 157	Applications for Certificates of Public Convenience and Necessity and for Orders Permitting and Approving Abandonment Under Section 7 of the Natural Gas Act
18-CFR-Part 380.12	Environmental reports for Natural Gas Act applications
18-CFR-Part 380.15	Siting and maintenance requirements
18-CFR-Part 385	eCFR Electronic Code of Federal Regulations
29-CFR-Part 1910	General Industry OSHA Safety and Health Standard
29-CFR-Part 1926	Safety and Health Regulations for Construction
33-CFR-Part 104	Maritime Security: Vessel Security
33-CFR-Part 105	Maritime Security: Facilities
33-CFR-Part 127	Waterfront Facilities Handling Liquefied Natural Gas And Liquefied Hazardous Gas
33-CFR-Part 165	Regulated Navigation Areas and Limited Access Areas
33-CFR-Part 320 - 332	General Regulatory Policies
40-CFR-Part 71	Federal Operating Permit Programs
40-CFR-Part 80	Regulation of Fuels and Fuel Additives
40-CFR-Part 112	Oil Pollution Prevention
40-CFR-Part 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System
40-CFR-Part 124	Procedures for Decision making
40-CFR-Part 125	Criteria and Standards for National Pollutant Discharge Elimination System
40-CFR-Part 144	Underground Injection Control Program
40-CFR-Part 147	State, Tribal, and EPA-Administered Underground Injection Control Programs
40-CFR-Part 260 – 271	Hazardous Waste Management System
40-CFR-Part 1502	Environmental Impact Statement
47-CFR-Part 100	Direct Broadcast Satellite Service
47-CFR-Part 101	Fixed Microwave Services
47-CFR-Part 80	Stations in the Maritime Services
47-CFR-Part 90	Private Land Mobile Radio Services
49-CFR-Part 171-180	Hazardous Material Regulation: Transportation
49-CFR-Part 191	Transportation of Natural and Other Gas by Pipeline; Annual Reports, Incident Reports, and Safety-Related Condition Reports



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<u>Standard</u>	<u>Description</u>
49-CFR-Part 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
49-CFR-Part 193	Liquefied Natural Gas Facilities Federal Safety Standards
50-CFR-Part 13	Renewal of Permits
50-CFR-Part 18	Marine Mammals – Regulatory Information
50-CFR-Part 22.25	Requirements concerning permits to take golden eagle nests
50-CFR-Part 216	Regulations governing the taking and importing of marine mammals
Aluminum Design Manual (AA	ADM)
AA ADM - 105	Aluminum Design Manual
American Association of State	Highway and Transportation Officials (AASHTO)
AASHTO GDHS	A Policy on Geometric Design of Highways and Streets, 6th Edition
AASHTO GDPS	Guide for Design of Pavement Structures
AASHTO LRFDUS-7	AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 7th Edition, with 2015 Interim Revisions
American Bearing Manufacture	ers Association (ABMA)
ABMA/ANSI 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA/ANSI 11	Load Ratings and Fatigue Life for Roller Bearings
Federal Aviation Administration	n Advisory Circular (AC)
AC 70/7460-1K	Federal Aviation Administration Advisory Circular - Obstruction Marking and Lighting
American Concrete Institute (A	<u>CI)</u>
ACI 117-10	Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 207.1R	Guide to Mass Concrete
ACI 209R-92	Prediction of Creep, Shrinkage and Temperature Effects in Concrete Structures
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 229R	Controlled Low Strength Materials
ACI 301	Specifications for Structural Concrete
ACI 302.1R	Guide for Concrete Floor and Slab Construction
ACI 304.2R	Placing Concrete by Pumping Methods
ACI 304R	Guide for Measuring, Mixing, Transportation and Placing Concrete
ACI 306R	Guide to Cold Weather Concreting
ACI 308R	Guide to Curing Concrete
ACI 311.4R	Guide for Concrete Inspection
ACI 315	Details and Detailing of Concrete Reinforcement
	Building Code Requirements for Structural Concrete and Commentary
ACI 318	Building Gode Requirements for Graciara Gonerete and Commentary
ACI 318 ACI 336.1	Specification for the Construction of Drilled Piers
ACI 336.1	Specification for the Construction of Drilled Piers



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<u>Standard</u>	<u>Description</u>
ACI 351	Machine Foundations
ACI 351.1R	Report on Grouting Between Foundations and Bases for Support of Equipment & Machinery
ACI 351.2R	Report on Foundations for Static Equipment
ACI 351.3R	Foundations for Dynamic Equipment
ACI 357.3R	Guide for Design and Construction of Waterfront and Coastal Concrete Marine Structures
ACI 357R	Guide for the Design and Construction of Fixed Offshore Concrete Structures
ACI 360R	Guide to Design of Slabs on Ground
ACI 372R	Design and Construction of Circular Wire- and Strand Wrapped- Prestressed Concrete Structure
ACI 373R	Construction of Circular Prestressed Concrete Structures with Circumferential Tendons
ACI 376	Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases and Commentary
ACI 504R	Guide to Sealing Joints in Concrete Structures
ACI 506.2	Specification for Shotcrete
ACI ITG-4.1-07	Specification for High-Strength Concrete in Moderate to High Seismic Applications
ACI ITG-4.2R-06	Materials and Quality Considerations for High-Strength Concrete in Moderate to High Seismic Applications
ACI ITG-4.3R-07	Report on Structural Design and Detailing for High-Strength Concrete in Moderate to High Seismic Applications
ACI SP 66	ACI Detailing Manual
Alaska Administrative Code (A	AC)
03 AAC 35	Timely Payments, Penalties & Interest
11 AAC 16	Historic, Prehistoric and Archaeological Resources
11 AAC 58	Leasing of Lands
11 AAC 71	Timber and Material Sales
11 AAC 93	Water Management
11 AAC 95	Forest Resources and Practices
11 AAC 96	Miscellaneous Land Use
13 AAC 50	Codes & Standards
17 AAC 10	Transportation/ Public Facilities – Engineering & Encroachments
17 AAC 15	Utility and Railroad Permits
17 AAC 20	Maintenance
17 AAC 25	Transportation and Public Facilities – Miscellaneous Provisions
18 AAC 15	Administrative Procedures
18 AAC 50	Air Quallity Control
18 AAC 60	Solid Waste Management
18 AAC 70	State Operating Permit Programs
18 AAC 72	Wastewater Disposal



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<u>Standard</u>	<u>Description</u>
18 AAC 75	Oil and Other Hazardous Substances Pollution Control
18 AAC 83	Alaska Pollutant Discharge Elimination System Program
Alaska Administrative Code (Chapter 70)	Alaska Statues and Regulations - Electrical Safety Code
Alaska Department of Environ	mental Conservation (ADEC)
ADEC	Division of Water, Snow Disposal Area Siting Guidance
ADEC	Division of Water, Alaska Storm Water Guide, December 2011
ADEC	Division of Environmental Health
ADEC	Division of Air Quality
ADEC	Division of Spill Prevention and Response
ADEC	Air Permit Program
Alaska Department of Transpor	rtation (ADOT)
ADOT&PF	ADOT&PF, Alaska Highway Drainage Manual
Association of Edison Illuminat	ting Companies (AEIC)
AEIC CS8	Specification for Extruded Dielectric Shielded Power Cables Rated 5 through 46 KV
American Gas Association (AG	<u>A)</u>
AGA Rpt N.3	Orifice Metering of Natural Gas
AGA Rpt N.5	Fuel Gas Energy Metering
AGA Rpt N.7	Measurement of Natural Gas by Turbine Meter
AGA Rpt N. 8	Compressibility Factors of Natural Gas and Other Related Hydrocarbon Gases
AGA Rpt N. 9	Measurement of Gas By Multi-Path Ultrasonic Meters
AGA Rpt N. 10	Speed Of Sound in Natural Gas and Other Related Hydrocarbon Meters
Asphalt Institute (AI)	
AI IS-91	Full-Depth Asphalt Pavements for Parking Lots, Service Stations, and Driveways
Al IS-96	How to Design Full-Depth Asphalt Pavements for Streets
AI MS-1	MS-1 Thickness Design-Highways & Streets
AI MS-2	MS-2 Asphalt Mix Design Methods
AI MS-16	Asphalt in Pavement Preservation & Maintenance
AI MS-17	Asphalt Overlays for Highway and Street Rehabilitation
AI MS-22	Construction of Hot-Mix Asphalt Pavements
AI MS-23	Thickness Design Asphalt Pavements for Heavy Wheel Loads
American Institute of Steel Con	struction (AISC)
AISC 303-05	Code of Standard Practice for Steel Buildings and Bridges
AISC 325	Steel Construction Manual
AISC 326-02	Detailing for Steel Construction, 2nd Ed.
AISC 341-05	Seismic Provisions for Structural Steel Buildings
AISC 358-05	Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications



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<u>Standard</u>	<u>Description</u>
AISC 360-05	Specification for Structural Steel Buildings
Alaska Natural Gas Pipelin	e Act (ANGPA)
Alaska National Interest La	nd Conservation Act(ANILCA, P.L. 96-487)
American National Standar	ds Institute (ANSI)
ANSI/ICEA S-108-720	Standard for Extruded Insulation Power Cables Above 46 Through 345 KV
ANSI / ISA 84.00.01	Functional Safety - Safety Instrumented Systems for the Process Industry Sector
ANSI B16.20	Metallic Gaskets for Pipe Flanges – Ring-Joint, Spiral Wound and Jacketed
ANSI B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ANSI B16.47	Large Diameter Steel Flanges, NPS 26 Through NPS 60 Metric/Inch Standard
ANSI C37.121	Unit Substation Requirements (When part of a Unit Substation)
ANSI C39.1	Requirements for Electrical Analog Indicating Instruments
ANSI C84.1	Electric Power Systems and Equipment – Voltage Ratings (60 Hz)
ANSI MC 96.1	Temperature Measurement Thermocouples
ANSI TIA-568-C.1-1	Commercial Building Telecommunications Cabling Standard (Addendum 1- Pathways and Spaces)
ANSI TIA-569-C	Telecommunications Pathways and Spaces
ANSI TIA-606-B	Administration Standard for Telecommunications Infrastructure
ANSI TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
ANSI Z55.1	Grey Finishes For Industrial Apparatus and Equipment
ANSI/FCI 70-2	Control Valve Seat Leakage
ANSI/ISA 75.01.01	Flow Equations for Sizing Control Valves
ANSI/AIHA Z79.5	Laboratory Ventilation Standard
American Petroleum Institu	ute (API)
API 500	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities
API 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, and Zone 2
API 520, Part I	Sizing, Selection, and Installation of Pressure-relieving Devices, Part I – Sizing and Selection
API 520, Part II	Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries-Part II, Installation
API 521	Pressure-Relieving and Depressuring Systems
API 526	Flanged Steel Pressure Relief Valves
API 527	Seat Tightness of Pressure Relief Valves
API 530	Calculation of Heater-tube Thickness in Petroleum Refineries
API 537	Flare Details for General Refinery and Petrochemical Service
API 541	General Purpose Squirrel Cage Induction motors (spared), (Category C) including following: Squirrel Cage Induction motors 800 HP (600 kW) and larger for 2 pole speed; Squirrel Cage Induction motors 3,000 HP (2,250 kW) and larger for 4, 6 and 8 pole speed
API 546	Brushless Synchronous Machines – 500 kVA and Larger



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<u>Standard</u>	<u>Description</u>
API 547	General Purpose duty, Squirrel Cage Induction motors (Category B) including following: a. Squirrel Cage Induction motors from 250 HP (186 kW) and less than 3,000 HP (2250 kW) for 4, 6, and 8 pole speeds b. Squirrel Cage Induction motors less than 800 HP (600 kW) for 2 pole speed c. Squirrel Cage Induction motors less than 1,250 HP (930 kW) for WPII enclosure for 2 pole speed
API 560	Fired Heaters for General Refinery Service
API 594	Check Valves: Flanged, Lug, Wafer and Buttwelding
API 598	Valve Inspection and Testing
API 600	Steel Gate Valves – Flanged and Butt-Welding Ends, Bolted Bonnets
API 602	Steel Gate, Globe and Check Valves for Sizes DN 100 and Smaller for Petroleum and Natural Gas Industries
API 607	Fire Test for Soft-Seated Quarter-Turn Valves – Sixth Edition
API 608	Metal Ball Valves-Flanged and Butt Welding Ends
API 609	Butterfly Valves: Double Flanged, Lug- and Wafer-Type
API 610	Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API 611	General-purpose Steam Turbines for Petroleum, Chemical, and Gas Industry Service
API 613	Special Purpose Gear Units for Petroleum, Chemical, and Gas Industry Services
API 614	Lubrication, Shaft-sealing and Oil-control Systems and Auxiliaries
API 616	Gas Turbines for Petroleum, Chemical, and Gas Industry Services
API 617	Axial and Centrifugal Compressors and Expander-compressors
API 618-5	Reciprocating Compressors for Petroleum, Chemical, and Gas Industry Services
API 619-5	Rotary Type Positive Displacement Compressors for Petroleum, Petrochemical and Natural Gas Industries
API 620	Design and Construction of Large, Welded, Low-pressure Storage Tanks
API 625	Tank Systems for Refrigerated Liquefied Gas Storage
API 650	Welded Tank for Oil Storage
API 660	Shell-and-Tube Heat Exchangers
API 661	Petroleum, Petrochemical, and Natural Gas Industries-Air-cooled Heat Exchangers
API 670	Machinery Protection Systems
API 671	Special-Purpose Couplings for Petroleum, Chemical, and Gas Industry Services
API 672	Packaged, Integrally Geared Centrifugal Air Compressors for Petroleum, Chemical, and Gas Industry Service
API 673	Centrifugal Fans for Petroleum, Chemical, and Gas Industry Services
API 674	Positive Displacement Pumps – Reciprocating
API 675	Positive Displacement Pumps – Controlled Volume for Petroleum, Chemical, and Gas Industry Services
API 676	Positive Displacement Pumps – Rotary
API 677	General Purpose Gear Units for Refinery Service
API 682	Pumps – Shaft Sealing Systems for Centrifugal and Rotary Pumps



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API 2000 Venting Atmospheric and Low-Pressure Storage Tanks Non-refrigerated and Refrigerated API 2350 Overfill Protection for Petroleum Storage Tanks API 2510 Design and Construction of Liquefled Petroleum Gas (LPG) Installations Fire-Protection Considerations for the Design and Operation of Liquefled Petroleum Gas (LPG) Storage Facilities API 2510A Fire-Protection Considerations for the Design and Operation of Liquefled Petroleum Gas (LPG) Storage Facilities API 2530 Concentric, Square-edged Orifice Meters Parts 1 through 4 Measurement of Petroleum Liquid Hydrocarbons by Turbine Meters API 2535 Turbine Meter Installation in Liquid Services API 2545 Method of Gauging Petroleum and Petroleum Products API 2546 Method for Liquid Calibration of Tanks API Bulletin 2521 Use of Pressure Vacuum Vent Valves for Atmospheric Pressure Tanks to Reduce Evaporation Losses API MPMS 2.2A Method for Measurement and Calibration of Upright Cylindrical Tanks by the Optical Reference Line Method API MPMS 3.X (Chapter 3) Manual of Petroleum Measurement Standards - Chapter 3 - Tank Gauging API MPMS 4.X (Chapter 4) Manual of Petroleum Measurement Standards - Chapter 4: Proving Systems API MPMS 5.X (Chapter 5) Manual of Petroleum Measurement Standards Chapter 5 - Measurement of Liquid Hydrocarbons API MPMS 6.X (Chapter 6) Manual of Petroleum Measurement Standards Chapter 6 - Metering Assemblies API MPMS 6.X (Chapter 7) Manual of Petroleum Measurement Standards Chapter 7: Temperature Determination API MPMS 12.X (Chapter 12) Manual of Petroleum Measurement Standards Chapter 8 - Sampling API MPMS 14.3 P1 (Chapter 12) Manual of Petroleum Measurement Standards - Chapter 12: Calculation of Petroleum Measurement Standards - Chapter 12: Calculation of Petroleum Measurement Standards - Chapter 12: Flow Measurement API MPMS 14.3 P1 (Chapter 12) Manual of Petroleum Measurement Standards - Chapter 12: Flow Measurement API MPMS 22.X (Chapter 20) Manual of Petroleum Measurement Standards - Chapter 12: Flow Measurement API MPMS 22	<u>Standard</u>	<u>Description</u>
API 2510 Design and Construction of Liquefied Petroleum Gas (LPG) Installations Fire-Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities API 2530 Concentric, Square-edged Orifice Meters Parts 1 through 4 API 2534 Measurement of Petroleum Liquid Hydrocarbons by Turbine Meters API 2535 Turbine Meter Installation in Liquid Services API 2545 Method of Gauging Petroleum and Petroleum Products API 2555 Method for Liquid Calibration of Tanks API Bulletin 2521 Use of Pressure Vacuum Vent Valves for Atmospheric Pressure Tanks to Reduce Evaporation Losses API MPMS 2.2A Method for Measurement and Calibration of Upright Cylindrical Tanks by the Optical Reference Line Method API MPMS 3.X (Chapter 3) Manual of Petroleum Measuring Standards - Chapter 3 - Tank Gauging API MPMS 4.X (Chapter 4) Manual of Petroleum Measurement Standards - Chapter 4: Proving Systems API MPMS 5.X (Chapter 5) Manual of Petroleum Measurement Standards Chapter 6 - Metering Assemblies API MPMS 6.X (Chapter 6) Manual of Petroleum Measurement Standards Chapter 7: Temperature Determination API MPMS 6.X (Chapter 7) Manual of Petroleum Measurement Standards Chapter 8 - Sampling API MPMS 12.X (Chapter 8) Manual of Petroleum Measurement Standards Chapter 8 - Sampling API MPMS 12.X (Chapter 12) Manual of Petroleum Measurement Standards Chapter 8 - Sampling API MPMS 14.3 P1 (Chapter 4) Manual of Petroleum Measurement Standards - Chapter 12: Calculation of Petroleum Quaritities API MPMS 14.3 P1 (Chapter 20) Manual of Petroleum Measurement Standards - Chapter 12: Calculation of Petroleum Measurement Standards - Chapter 12: Tanks Measurement API MPMS 22.X (Chapter 20) Manual of Petroleum Measurement Standards - Chapter 12: Flow Measurement API MPMS 22.X (Chapter 21) Manual of Petroleum Measurement Standards - Chapter 12: Flow Measurement API MPMS 22.X (Chapter 22) Manual of Petroleum Measurement Standards - Chapter 12: Flow Measurement API MPMS 22.X (Chapter 22) Manual of Petroleum Measure	API 2000	Venting Atmospheric and Low-Pressure Storage Tanks Non-refrigerated and Refrigerated
API 2510A Fire-Protection Considerations for the Design and Operation of Liquefied Petroleum Gas (LPG) Storage Facilities Concentric, Square-edged Orifice Meters Parts 1 through 4	API 2350	Overfill Protection for Petroleum Storage Tanks
(LPG) Storage Facilities API 2530 Concentric, Square-edged Orifice Meters Parts 1 through 4 API 2534 API 2535 Turbine Meter Installation in Liquid Services API 2535 API 2545 Method of Gauging Petroleum Liquid Hydrocarbons by Turbine Meters API 2555 API 2555 Method for Liquid Calibration of Tanks API 2555 Method for Liquid Calibration of Tanks API 2555 API Bulletin 2521 Use of Pressure Vacuum Vent Valves for Atmospheric Pressure Tanks to Reduce Evaporation Losses API MPMS 2.2A Method for Measurement and Calibration of Upright Cylindrical Tanks by the Optical Reference Line Method API MPMS 3.X (Chapter 3) API MPMS 3.X (Chapter 3) API MPMS 4.X (Chapter 4) API MPMS 5.X (Chapter 4) API MPMS 5.X (Chapter 5) API MPMS 5.X (Chapter 5) API MPMS 6.X (Chapter 6) API MPMS 6.X (Chapter 6) API MPMS 6.X (Chapter 6) API MPMS 6.X (Chapter 7) API MPMS 8.X (Chapter 8) API MPMS 12.X (Chapter 8) API MPMS 12.X (Chapter 12) API MPMS 14.3 P1 (Chapter 14) API MPMS 14.3 P1 (Chapter 14) API MPMS 15.X (Chapter 22) API MPMS 2.X (Chapter 23) API MPMS 2.X (Chapter 24) API MPMS 2.X (Chapter 25) API MPMS 2.X (Chapter 26) API MPMS 2.X (Chapter 27) API MPMS 2.X (Chapter 28) API MPMS 2.X (Chapter 29) API MPMS 2.X (Chapter 29) API MPMS 2.X (Chapter 29) API MPMS 2.X (Chapter 20) API MPMS 2.X (Chapter 2	API 2510	Design and Construction of Liquefied Petroleum Gas (LPG) Installations
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API RP 578	Material Verification Program for New and Existing Alloy Piping Systems
API RP 582	Welding Guidelines for the Chemical, Oil and Gas Industries
API RP 651	Recommended Practices Cathodic Protection of Aboveground Petroleum Storage Tanks
API RP 752	Recommended Practices Management of Hazards Associated With Location of Process Plant Buildings
API RP 753	Recommended Practices Management of Hazards Associated With Location of Process Plant Portable Buildings
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API RP 2030	Application of Fixed Water Spray Systems for Fire Protection in the Petroleum and Petrochemical Industries
API RP 2218	Fireproofing Practices in Petroleum and Petrochemical Processing Plants
API RP 2350	Overfill Protection for Storage Tanks in Petroleum Facilities
API RP2A 2014	Recommended Practice for Planning, Designing and Constructing Fixed offshore Platforms – WSD, $22^{\rm nd}$ Edition
API SPEC 5L-44	Specification for Line Pipe
API SPEC 6D	Specification for Pipeline Valves
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ASCE 7-05	Minimum Design Loads for Buildings and Other Structures
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ASCE 41088	Design of Blast Resistant Buildings in Petrochemical Facilities
ASCE 41140	Guidelines for Seismic Evaluation and Design of Petrochemical Facilities
ASCE 41180	Wind Loads for Petrochemical and Other Industrial Facilities
ASCE 41258	Anchorage Design for Petrochemical Facilities
American Society of Heatin	g, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
ASHRAE	Handbook HVAC Applications
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ASHRAE 52.1	Gravimetric and Dust-Spot Procedure for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 55	Thermal Environmental Conditions for Human Occupancy
ASHRAE 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE 90.1	Energy Efficient Design for New Buildings
ASHRAE 90453 (2012)	Thermal Guidelines for Data Processing Environments Third Edition
American Society of Mecha	nical Engineers (ASME)
ASME BPVC	ASME Boiler and Pressure Vessel Code including all mandatory addenda
ASME B1.20.1	Pipe Threads General Purpose (Inch)
ASME B16.1	Gray Iron pipe flanges and flanged fittings
ASME B16.3	Malleable Iron Threaded Fittings: Classes 150 and 300
ASME B16.5	Pipe Flanges and Flanged Fittings – NPS ½ through 24
ASME B16.9	Factory Made Wrought Steel Buttwelding Fittings
ASME B16.10	Face-to-Face and End-to-End Dimensions of Valves
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.20	Metallic Gaskets for Pipe Flanges: Ring Joint, Spiral Wound and Jacketed
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges



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<u>Standard</u>	<u>Description</u>
ASME B16.25	Butt-Welding Ends
ASME B16.34	Valves - Flanged, Threaded, and Welding End; Supplement: December 2010
ASME B16.36	Orifice Flanges
ASME B16.47	Large Diameter Steel Flanges
ASME B16.48	Line Blanks
ASME B30.2	Overhead and Gantry Cranes
ASME B31.1	Power Piping
ASME B31.3	Process Piping
ASME B31.4	Liquid Transportation Systems for Hydrocarbon, Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohols
ASME B31.5	Refrigeration Piping and Heat Transfer Components
ASME B31.8	Gas Transmission and Distribution Piping Systems
ASME B36.10/B36.10M	Welded and Seamless Wrought Steel Pipe
ASME B36.19/B36.19M	Stainless Steel Pipe
ASME B40.1	Gauges - Pressure Indicating Dial Type - Elastic Element
ASME B46.1	Surface Texture, Surface Roughness, Waviness, and Lay
ASME B73.1	Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process
ASME B73.3	Specification for Sealless Horizontal End Suction Metallic Centrifugal Pumps for Chemical Process
ASME MFC-3M	Measurement of Fluid Flow in Pipes Using Orifice, Nozzles and Venturi
ASME PCC-1	Guideline for Pressure Boundary Bolted Flange Joint Assembly
ASME PTC 10	Test Code on Compressors & Exhausters
ASME PTC-17	Reciprocating Internal Combustion Engines (Performance Test Codes)
ASME PTC 22	Gas Turbines
ASME PTC-30	Air Cooled Heat exchangers
ASME Section I	Rules for Construction of Power Boilers
ASME Section V	Non-Destructive Examination
ASME Section VIII	Rules for Construction of Pressure Vessels
ASME Section IX	Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators
American Society of Safety En	gineers (ASSE)
ASSE A1264.1	Safety Requirements for Workplace Walking/Working Surfaces & Their Access; Workplace Floor, Wall & Roof Openings; Stairs & Guardrails Systems
American Society of Testing &	Materials (ASTM)
ASTM A1	Standard Specification for Carbon Steel Tee Rails
ASTM A3	Standard Specification for Steel Joint Bars, Low, Medium, and High Carbon (Non-Heat Treated).
ASTM A 6/A 6M	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling



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<u>Standard</u>	<u>Description</u>
ASTM A36	Standard Specification for Carbon Structural Steel.
ASTM A49	Standard Specification for Heat Treated Carbon Steel Joint Bars Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars.
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
ASTM A90	Standard Test Method for Weight [Mass] of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings.
ASMT A106	Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service
ASTM A108	Standard Specification for Steel Bars, Carbon, Cold-Finished.
ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A 123/A 123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
ASTM A 153/A 153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A185	Standard Specification for Welded Steel Wire Fabric For Concrete Reinforcement
ASTM A194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
ASTM A240	Chromium and Chormium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and General Applications
ASTM A249	Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A252	Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength
ASTM A312	Standard Specification for Seamless, Welded, and Heavily Cold-Worked Austenitic Stainless Steel Pipes
ASTM A320	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
ASTM A333	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service
ASTM A353	Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double Normalized and Tempered
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
ASTM A384	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A403	Standard Specification for Wrought Austenitic Stainless Steel Piping
ASTM A416	Steel Strand, Uncoated Seven Wire for Prestressed Concrete
ASTM A420	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service



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<u>Standard</u>	<u>Description</u>
ASTM A449	Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A463	Steel Sheet, Aluminum Coated, by the Hot Dip Process
ASTM A490	Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.
ASTM A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A497	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
ASTM A501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
ASTM A516	Pressure Vessel Plates, Carbon Steel, for Moderate and Lower Temperature Service
ASTM A525	Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
ASTM A553	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts.
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
ASTM A588	Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
ASTM A668	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
ASTM A673	Standard Specification for Sampling Procedure for Impact Testing of Structural Steel.
ASTM A700	Standard Practices for Packaging, Marking and Loading Methods for Steel Products for Shipment.
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
ASTM A759	Standard Specification for Carbon Steel Crane Rails.
ASTM A780	Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coating
ASTM A786	Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
ASTM A817	Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire
ASTM A924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot- Dip Process.
ASTM A992	Standard Specification for Structural Steel Shapes.
ASTM A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.



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<u>Standard</u>	<u>Description</u>
ASTM B3	Specification for Soft or Annealed Copper Wire
ASTM B8	Specification for Concentric Lay Standard Copper Conductors, Hard, Medium- Hard, or Soft
ASTM B62	150# Gate Valves, Cast Bronze, Solid Wedge Type Potable Water Systems
ASTM B88	Specification for Seamless Copper Water Tube (For Type "K" and Type "L" Hot and Cold
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B236	Standard Specification for Aluminum Bars for Electrical Purposes Bus Bars)
ASTM B317/B 317M	Standard Specification for Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Structural Profiles for Electrical Purposes (Bus Conductor)
ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
ASTM B828	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube & Fittings
ASTM C14	ASTM C14, Standard for Nonreinforced Concrete Sewer, Storm Drain and Culvert Pipe
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field.
ASTM C33	Standard Specification for Concrete Aggregates.
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C42	Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
ASTM C94	Standard Specification for Ready-Mixed Concrete.
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50mm Cube Specimens)
ASTM C117	Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete.
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete.
ASTM C150	Standard Specification for Portland Cement.
ASTM C 167	Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete.
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete.
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 177	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete.
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.



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<u>Standard</u>	<u>Description</u>
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C 450	Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments
ASTM C494	Standard Specification for Chemical Admixtures for Concrete.
ASTM C531	Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534/C 534M	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C535	Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C549	Standard Specification for Perlite Loose Fill Insulation
ASTM C 552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C564	Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings. (For neoprene compression type gaskets)
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes
ASTM C 585	Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
ASTM C 591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
ASTM C 680	Standard Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
ASTM C 795	Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C 871	Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
ASTM C920	Standard Specification for Elastomeric Joint Sealants.
ASTM C 929	Standard Practice for Handling, Transporting, Shipping, Storage, Receiving, and Application of Thermal Insulation Materials for Use in Contact with Austenitic Stainless Steel
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
ASTM C1090	Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
ASTM C 1104/C 1104M	Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete.



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ASTM C1218 Standard Test Method for Water-Soluble Chloride in Mortar and Concrete. ASTM C1330 Slandard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants. ASTM C1433 Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete ASTM C 1639 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete ASTM C 1639 Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation ASTM D422 Standard Test Method for Particle-Size Analysis of Soils ASTM D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbriff3 (600 kN m/m3)) ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer Than 75-µm (No. 200) Sieve in Soils by Washing ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1255 Standard Practice for Sampling Liquefle Petroleum (LP) Gases, Manual Method ASTM D1355 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbff3 (2,700 kN-m/m3)) ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbff3 (2,700 kN-m/m3)) ASTM D1621 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D1752 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 Construction (Non-extruding and Resilient Biuminious Types) ASTM D2167 Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40, 80, and 120 Standard	<u>Standard</u>	<u>Description</u>
Sealants. ASTM C1433 Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete ASTM C1639 Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation ASTM D422 Standard Test Method for Particle-Size Analysis of Soils Standard Classification for Sizes of Aggregate for Road and Bridge Construction ASTM D448 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12.400 ft-libf/d) (600 kM m/m3)) ASTM D698 Standard Test Methods for Determining the Amount of Material Finer Than 75-µm (No. 200) Sieve in Soils by Washing ASTM D1140 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1441 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses ASTM D1255 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1556 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-libf/d) (2,700 kM-m/m3)) ASTM D1557 Standard Test Methods for Caboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-libf/d) (2,700 kM-m/m3)) ASTM D1621 Standard Test Methods for Caboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-libf/d) (2,700 kM-m/m3)) ASTM D1622 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D1621 Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D2167 Standard Specification for Poly (Vinyl Chioride) (PVC) Plastic P	ASTM C1218	Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete ASTM C1609 Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation ASTM D422 Standard Test Method for Particle-Size Analysis of Soils ASTM D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction ASTM D48 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbif13 (600 kM m/m3)) ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer Than 75-µm (No. 200) Sieve in Soils by Washing ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses ASTM D1265 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1536 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbif13 (2,700 kM-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1751 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1752 Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D 1752 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D 1785 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D2167 Standard Specification for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2467 Standard Test Methods for Laboratory Determination	ASTM C1330	
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ASTM D422 Standard Test Method for Particle-Size Analysis of Soils ASTM D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbffft3 (600 kN m/m3)) ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer Than 75-µm (No. 200) Sieve in Soils by Washing ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1255 Standard Practice for Specifying Color by the Munsell System ASTM D1535 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1556 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2467 Standard Practice for Description and Identifica	ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbfff3 (600 kM m/m3)) ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer Than 75-µm (No. 200) Sieve in Soils by Washing ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses ASTM D1265 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1535 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbff3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction ASTM D 2167 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method Method Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass Standard Test Methods for Laboratory Determination of Soils (Visual-Manual Procedure) ASTM D2467 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil class	ASTM C 1639	Standard Specification for Fabrication of Cellular Glass Pipe and Tubing Insulation
ASTM D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ff3 (600 kN m/m3)) ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer Than 75-µm (No. 200) Sieve in Soils by Washing ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses ASTM D1265 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1535 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ff3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2685 Standard S	ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D1999 (12,400 ft-lbifft3 (600 kN m/m3)) ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer Than 75-µm (No. 200) Sieve in Soils by Washing ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses ASTM D1265 Standard Practice for Sampling Liquefled Petroleum (LP) Gases, Manual Method ASTM D1535 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,006 Inbifft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1622 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings Standard Specification	ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D1140 Sieve in Soils by Washing ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load ASTM D1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses ASTM D1265 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1535 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1622 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1751 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings Standard Specification for Polyethylene (PE) Plas	ASTM D698	
ASTM D1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses ASTM D1265 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1535 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2488 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3034 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1140	
ASTM D1265 Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method ASTM D1535 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1622 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1751 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1752 ASTM D1765 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Methods for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2487 Standard Test Methods for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings	ASTM D1143	Standard Test Methods for Deep Foundations Under Static Axial Compressive Load
ASTM D1535 Standard Practice for Specifying Color by the Munsell System ASTM D1556 Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/fft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1241	Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses
ASTM D1556 Standard Test Methods for Density and Unit Weight of Soil in Place by Sand-Cone Method ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbifft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1265	Standard Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method
ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1535	Standard Practice for Specifying Color by the Munsell System
Effort (56,000 ft-lbt/ft3 (2,700 kN-m/m3)) ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1557	
ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types). ASTM D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2167 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2216 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D 1621	Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D1751 Construction (Non-extruding and Resilient Bituminous Types). Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D 1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
ASTM D1785 Concrete Paving and Structural Construction. Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1751	
ASTM D2167 Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1752	
ASTM D2216 ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2472 Standard Specification for Sulfur Hexafluoride American Welding Society (AWS) ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D2167	
ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D2216	
ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D2472	Standard Specification for Sulfur Hexafluoride American Welding Society (AWS)
ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D2487	
ASTM D2937 Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D2665	Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter	ASTM D2937	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D3035 Outside Diameter	ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials	ASTM D3035	
	ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials



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<u>Standard</u>	<u>Description</u>
ASTM D3487	Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
ASTM D3689	Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
ASTM D3966	Standard Test Methods for Deep Foundations Under Lateral Loads
ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4253	ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4254	ASTM D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D4945	High-Strain Dynamic Testing of Piles
ASTM D5195	Standard Test Method for Density of Soil and Rock In-Place at Depths Below the Surface by Nuclear Methods
ASTM D5249	Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D5842	Standard Practice for Sampling and Handling of Fuels for Volatility Measurement
ASTM D5882	Standard Test Method for Low Strain Strain Impact Integrity Testing of Deep Foundations
ASTM D 6226	Standard Test Method for Open Cell Content of Rigid Cellular Plastics
ASTM D6299	Standard Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance
ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D6760	Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM E23	Standard Test Methods for Notched Bar Impact Testing of Metallic Materials
ASTM E165	Standard Practice for Liquid Penetrant Examination for General Industry
ASTM E 230	Standard Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples
ASTM E 235	Standard Specification for Thermocouples, Sheathed, Type K and Type N, for Nuclear or for Other High-Reliability Applications
ASTM E709	Standard Guide for Magnetic Particle Examination.
ASTM E 814	Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM E 1137/E 1137M	Standard Specification for Industrial Platinum Resistance Thermometers
ASTM F436	Standard Specification for Hardened Steel Washers.
ASTM F900	Standard Specification for Industrial and Commercial Swing Gates
ASTM F959	Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.



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<u>Standard</u>	<u>Description</u>
ASTM F1184	Standard Specification for Industrial and Commercial Horizontal Slide Gates
ASTM F1554	Standard Specification for Anchor Bolts (Anchor Rods), Steel, 36, 55 and 105-ksi Yield Strength.
ASTM F1852	Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
ASTM F2280	Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength
American Welding Society (AW	<u>s)</u>
AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0	Standard Welding Terms and Definitions, including Terms for Brazing, Soldering, Thermal Spraying and Thermal Cutting
AWS A4.2	Standard Procedures for Calibrating Magnetic Instruments to Measure Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal
AWS A5.1	Covered Carbon Steel Arc-Welding Electrodes
AWS A5.5	Low-Alloy Steel Covered Arc-Welding Electrodes
AWS A5.17	Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
AWS D1.1-06	Structural Welding Code
AWS D1.2/D1.2M-04	Structural Welding Code – Aluminum
AWS D1.4-98	Structural Welding Code-Reinforcing Steel
AWS D1.8-05	Structural Welding Code – Seismic Supplement
AWS WZC-72	Welding Zinc Coated Steel
Marine Oil Terminal Engineerin	g and Maintenance Standards (MOTEMS)
CBC 2007, Chapter 31F(Motems)	Marine Oil Terminals
American Water Works Associa	<u>ation</u>
AWWA D110A-13	Wire-and Strand-Wound Circular, Prestressed Concrete Water Tanks
Clean Water Act (CWA)	
SPCC Rule Section 311	Oil and Hazardous Substances Spills
Section 401	Water Quality Certifications
Section 402	National Pollutant Discharge Elimination System (NPDES)
Section 404	Permit Program
Concrete Reinforcing Steel Inst	itute (CRSI)
N/A	CRSI Manual of Practice
Canadian Standards Association	on (CSA)
CSA C22.1	Canadian Electrical Code
Electrical Engineer (EEMUA)	
EEMUA 191	Alarms Systems – A Guide to Design, Management and Procurement
Energy Information Administration (EIA)	
EIA/ECA-310-E	Cabinets, Racks, Panels, and Associated Equipment



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<u>Standard</u>	<u>Description</u>	
Expansion Joint Manufacture	r's Association (EJMA)	
EJMA 2	Standards of the Expansion Joint Manufacturer's Assocication, Inc.	
Fluid Components Internation	nal (FCI)	
FCI 70-2	Control Valve Seat Leakage	
Federal Emergency Managen	Federal Emergency Management Agency	
440 2005	Improvement of Nonlinear Static Analysis Procedures	
Federal Energy Regulation C	ommission (FERC) Guidance	
FERC 2007	Federal Energy Regulatory Commission Draft Seismic Design Guidelines and Data Submittal Requirements for LNG Facilities	
FERC 2013	Upland Erosion Control, Revegetation, and Maintenance Plan	
N/A	Resource Report 13 Draft Preferred Submittal Format Guidance	
Factory Mutual (FM)		
FM 5-4	Loss Prevention - Transformers	
Gas Processors Association	(GPA)	
GPA 181-86,	Tentative Reference Bulletin Heating Values as a Basis for Custody Transfer of Natural Gas	
GPA 2145	Table of Physical Constants for the Hydrocarbons and Other Compounds of Interest to the Natural Gas Industry	
GPA 2166	Methods for Obtaining Natural Gas Samples for Analysis by Gas Chromatography	
GPA 2172	Calculation of Gross Heating Value, Relative Density and Compressibility Factor for Natural Gas Mixtures for Compositional Analysis	
GPA 2261	Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography	
GPA 2265	Determination of Hydrogen Sulfide and Mercaptan Sulphur in Natural Gas	
Gas Research Institute (GRI)		
GRI Report 89/0176	LNGFIRE: A Thermal Radiation Model for LNG Fires	
GRI Report 89/0242	LNG Vapor Dispersion Prediction with the DEGADIS Dense Gas Dispersion Model	
International Building Code (BC)	
IBC-06	International Building Code	
IBC-09	International Building Code	
International Electrotechnica	Commission (IEC)	
IEC 60534-8-3	Industrial Process Control Valves Part 8-3	
IEC 61508	Functional Safety of Electrical/Electronic Programmable Electronic Safety Related Systems	
IEC 61511	Functional Safety – Safety Instrumented Systems for the Process Industry Sector	
IEC 61850	Communication Networks and Systems in Substations	
Institute of Electrical and Ele	ctronics Engineers (IEEE)	
IEEE NESC	IEEE National Electrical Safety Code	
IEEE 32	Standard Requirements, Terminology, and Test Procedure for Neutral Grounding Devices	
IEEE 62	Guide for Diagnostic Field Testing of Electrical Power Apparatus – Part 1: Oil Filled	



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<u>Standard</u>	<u>Description</u>
IEEE 80	IEEE Guide for Safety in AC Substation Grounding
IEEE 112	IEEE Standard Test Procedure for Polyphase Induction Motors and Generators
IEEE 115	Guide: Test Procedures for Synchronous Machines Part I – Acceptance and Performance Testing Part II – Test Procedures and Parameter Determination for Dynamic Analysis
IEEE 141	IEEE Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 142	Grounding of Industrial and Commercial Power Systems
IEEE 242	IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE 315	Graphic Symbols for Electrical and Electronics Diagrams
IEEE 315A	IEEE Supplement to Graphic Symbols to Electrical and electronics Diagrams
IEEE 399	Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE 400	IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems
IEEE 421.5	Recommended Practice for Excitation System Models for Power System Stability Studies
IEEE 422	IEEE Guide for the Design of Cable Raceway Systems for Electric Generating Facility
IEEE 446	IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
IEEE 450	Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
IEEE 485	Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications
IEEE 493	Electrical Reliability Analysis
IEEE 515	Standards for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications
IEEE 518	Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE 522	Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils Internal Arcing Faults
IEEE 525	IEEE Guide for the Design and Installation of Cable Systems in Substations
IEEE 575	IEEE Guide for the Bonding Shield and Sheaths of Single Conductor Power Cable Rated 5 KV through 500 KV
IEEE 576	IEEE Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications
IEEE 666	IEEE Design Guide for Electric Power Service Systems for Generating Stations
IEEE 730.1	Software Reliability Plans
IEEE 802	Standard for Local and Metropolitan Area Networks: Overview and Architecture – IEEE Computer Society Document
IEEE 828	Software Configuration Management Plans



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<u>Standard</u>	<u>Description</u>
IEEE 841	NEMA frame less than 500 HP (375 kW) General Purpose duty Squirrel cage Induction Motors (Category A)
IEEE 944	Recommended Practice for Application and Testing of Uninterruptible Power Supplies for Power Generating Stations
IEEE 946	Recommended Practice for the Design of DC Auxiliary Power Systems for Generating Stations
IEEE 979	IEEE Guide for Substation Fire Protection
IEEE 980	IEEE Guide for Containment and Control of Oil Spills in Substations
IEEE 1042	Software Configuration Management
IEEE 1184	IEEE Guide for Batteries for Uninterruptable Power Supply Systems
IEEE 1187	IEEE Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
IEEE 1189	IEEE Guide for Selection of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
IEEE 1202	Standard for Flame-Propagation Testing of Wire and Cable
IEEE 1584	Guide for Performing Arc-Flash Hazard Calculations
IEEE-1613	Communication Networks and System in Substation
IEEE C2	National Electrical Safety Code (NESC); also identified as ANSI C2
IEEE C37	Circuit Breakers, Switchgear, Relays, Substations and Fuses
IEEE C37.2	Electrical Power System Device Function Numbers and Contact Descriptions
IEEE C37.04	Standard Rating Structure for AC High-Voltage Circuit Breakers
IEEE C37.04b	EEE Standard for Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis, Amendment 2: To Change the Description of Transient Recovery Voltage for Harmonization with IEC 62271-100
IEEE C37.06	AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
IEEE C37.06.1	Guide for High-Voltage Circuit Breakers rated on Symmetrical Current Basis Designated "Definite Purpose for Fast Transient Recovery Voltage Rise Times"
IEEE C37.09	Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.010	Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.013	AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.082	Standard Method for the Measurement of Sound Pressure Level of AC Power Circuit Breakers
IEEE C37.11	Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.13	Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors- Preferred Ratings, Related Requirements and Application Recommendations
IEEE C37.17	Standard for Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers



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<u>Standard</u>	<u>Description</u>
IEEE C37.20.2	Standard for Metal-Clad Switchgear
IEEE C37.20.3	Standard for Metal-Enclosed Interrupter Switchgear
IEEE C37.20.6	4.76 kV to 38 kV Rated Grounding and Testing Devices Used in
IEEE C37.20.7	Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults
IEEE C37.21	Standard for Control Switchboards
IEEE C37.23	Guide for Metal-Enclosed Bus and Calculating Losses in Isolated-Phase Bus
IEEE C37.27	Application Guide for Low-Voltage AC Power Circuit Breakers Applied with Separately Mounted Current-Limiting Fuses
IEEE C37.81	Guide for Seismic Qualification of Class 1E Metal-Enclosed Power Switchgear Assemblies
IEEE C37.90	Standard for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C37.90.1	Surge Withstand Capability Test for Protective Relays and Relay Systems
IEEE C37.90.2	Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers
IEEE C37.90.3	Standard Electrostatic Discharge Tests for Protective Relays
IEEE C37.100	Standard Definitions for Power Switchgear
IEEE C37.106	IEEE Standard for AC High-Voltage Circuit Switchers rated 15.5 kV through 245 kV
IEEE C37.122.1	Guide for Gas-Insulated Substations Rated Above 52kV
IEEE C50.13	Cylindrical-Rotor 50 Hz and 60 Hz Synchronous Generators Rated 10 MVA and Above
IEEE C57.12.00	Standard Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid-Cast and /or Resin-Encapsulated Windings
IEEE C57.12.10	Standard Requirements for Liquid-Immersed Power Transformers
IEEE C57.12.51	Standard Requirements for Ventilated Dry-Type Power Transformers 501 KVA and Larger
IEEE C57.12.70	Standard Terminal Markings and Connections for Distribution and Power Transformers
IEEE C57.12.90	Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.91	Standard Factory Tests for Distribution, Power and Regulating Transformers
IEEE C57.13	Standard Requirements for Instrument Transformers
IEEE C57.13.2	Requirements for Instruments Transformers
IEEE C57.19.00	General Requirements and Test Procedure for Power Apparatus Bushings
IEEE C57.19.01	Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
IEEE C57.91	Guide for Loading Mineral-Oil-Immersed Transformers
IEEE C57.96	IEEE Guide for Loading Dry Type Distribution and Power Transformers
IEEE C57.98	Guide for Transformer Impulse Tests



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<u>Standard</u>	<u>Description</u>
IEEE C57.104	Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers
IEEE C57.106	Guide for Acceptance and Maintenance of Insulating Oil in Equipment
IEEE C57.111	Guide for Acceptance of Silicon Insulating Fluid and Its Maintenance in Transformers
IEEE C57.113	Guide for Partial Discharge Measurement in Liquid-Filled Power Transformers and Shunt Reactors
IEEE C57.116	IEEE Guide for Transformers Directly Connected to Generators
IEEE C62.11	Standard for Metal-Oxide Surge Arresters for AC Power Circuits (> 1kV)
IEEE C62.22	Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems
IEEE C62.92.2	IEEE Guide for the Neural Grounding in Electrical Utility Systems, Part II - Grounding of Synchronous Generator Systems
IEEE C62.92.3	IEEE Guide for the Neural Grounding in Electrical Utility Systems, Part III - Grounding of Generator Auxiliary Systems
Illuminating Engineering Socie	ety of North America (IES)
IES	The Lighting Handbook
International Fire Code (IFC)	
IFC 2009	International Fire Code
International Society of Autom	ation (ISA)
ISA 5.1	Instrument Symbols and Identification
ISA 5.2	Binary Logic Diagrams for Process Operations
ISA 5.4	Instrument Loop Diagrams
ISA 5.5	Graphic Symbols for Process Displays
ISA 7.0.01	Quality Standard for Instrument Air
ISA 12	Electrical Equipment for Hazardous Locations
ISA 12.13.01	Performance Requirements for Combustible Gas Detectors
ISA 12.27.01	Requirements for Process Sealing Between Electric Systems and Flammable or Combustible Process Fluids
ISA 18.1	Annunciator Sequences and Specifications
ISA 18.2	Management of Alarm Systems for Process Industries
ISA 71.01	Environmental Conditions for Process Measurement and Control Systems:Temperature and Humidity
ISA 71.04	Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants
ISA 75.01.01	Flow Equations for Sizing Control Valves
ISA 75.17	Control Valve Aerodynamic Noise Prediction
ISA 84.00.01	Application of Safety Instrumented Systems for the Process Industry, Parts 1, 2, and 3
ISA 95	Enterprise-Control System Integration
ISA 99	Security for Industrial Automation and Control Systems
ISA 100.11A	Wireless Systems for Industrial Automation



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ISA MC 96.1	Temperature Measurement Thermocouples
ISA RP12.04	Instrument Piping for Reduction of Hazardous Area Classification
ISA RP12.06	Wiring Practices for Hazardous (Classified) Locations Instrumentation – Part 1 Intrinsic Safety
ISA RP 12.2.02	Recommendations for the Preparation, Content, and Organization of Intrinsic Safety Control Drawings
ISA RP 12.4	Pressurized Enclosures
ISA RP 31.1	Specification, Installation and Calibration of Turbine Flowmeters
ISA S18.1	Annunciator Sequences and Specifications
ISA S18.2	Management of Alarm System For the Process industries
ISA S20	Specification Forms for Process Measurements and Control Instruments, Primary Elements and Control Valves
ISA S5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, logic and Computer Systems
ISA TR84.00.07	Guidance on the Evaluation of Fire, Combustible Gas, & Toxic Gas System Effectiveness
International Standards C	organization (ISO)
ISO 8943	Refrigerated Light Hydrocarbon Fluids – Sampling of Liquefied Natural Gas – Continuous Method
ISO 9001	Quality Systems. Model for Quality Assurance in Design, Development, Production, and Installation
ISO 9004	Quality Management System - Guidelines for Performance Improvements
ISO 11064 Parts 1-7	Ergonomic Design of Control Centers
Kenai Peninsula Borough	(KPB) Ordinance
KPB Chapter 10	Health & Safety
KPB Chapter 14	Streets, Sidewalks, Roads and Trails
KPB Chapter 17	Borough Lands
Marine Mammal Protection	n Act (MMPA), Title 1
Marine Protection Resear	ch and Sanctuaries Act (MPRSA), Section 103
Metal Building Manufactu	rers Association (MBMA)
MBMA	Metal Building Systems Manual
Manufacturers Standardia	zation Society (MSS)
MSS SP-25	Standard Marking System for Valves, Fittings, Flanges, and Unions
MSS SP-44	Steel Pipeline Flanges
MSS SP-53	Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components – Magnetic Particle Examination Method
MSS SP-54	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components – Radiographic Examination Method
MSS SP-55	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components – Visual Method for Evaluating Surface Irregularities
MSS SP-58	Pipe Hangers and Supports - Material and Design
MSS SP-69	Pipe Hangers and Supports - Selection and Application



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<u>Standard</u>	<u>Description</u>
MSS SP-75	Specification for High-Test, Wrought, Butt-Welding Fittings
MSS SP-79	Socket Welding Reducer Inserts
MSS SP-83	Class 3000 Steel Pipe Unions Socket Welding and Threaded
MSS SP-89	Pipe Hangers and Supports - Fabrication and Installation Practices
MSS SP-93	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components – Liquid Penetrant Examination Method
MSS SP-95	Swage(d) Nipples and Bull Plugs
MSS SP-97	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded, and Buttwelding Ends
Municipality of Anchorage, Pro	ject Management & Engineering Department
N/A	Design Criteria Manual, Chapter 2 Drainage, Section 2.15
National Association of Corros	ion Engineering (NACE)
NACE MR0175	Petroleum and Natural Gas Industries – Materials for Use in H2S ISO 15156 Containing Environments in Oil and Gas Production – Parts 1, 2, and 3.
NACE RP 0169	Recommended Practice for Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP 0187	Recommended Practice Design Considerations for Corrosion Control of Reinforcing Steel in Concrete
NACE RP 0193	Recommended Practice External Cathodic Protection of On-Grade Carbon Steel Storage Tank Bottoms
NACE SP 0118	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE SP 0200	Standard Practice Steel-Cased Pipeline Practices
NACE SP 0286	Standard Practice Electrical Isolation of Cathodically Protected Pipelines
National Electrical Manufacture	ers Association (NEMA)
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C29.9	Wet Process Porcelain Insulators (Apparatus, Post-Type)
NEMA C29.10	Wet-Process Porcelain Insulators – Indoor Apparatus Type
NEMA C37.50	Switchgear Low Voltage AC Power Circuit Breakers Used in Enclosures – Test Procedures
NEMA C37.55	Switchgear- Medium –Voltage Metal-Clad Assemblies – Conformance Test Procedures
NEMA C80.1	Electrical Rigid Steel Conduit (ERSC)
NEMA C80.5	Electrical Rigid Aluminum Conduit (ERAC)
NEMA CC 1	Electric Power Connection for Substations
NEMA/ANSI C50.41	Polyphase Induction Motors for Generating Stations
NEMA/ANSI C80.1	Electrical Rigid Steel Conduit (ERSC)
NEMA/ANSI C80.5	Electrical Rigid Aluminum Conduit (ERAC)
NEMA/ANSI C80.6	Electrical Intermediate Metal Conduit
NEMA/ANSI C84.1	American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)



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NEMA FU-1	Low Voltage Cartridge Fuses		
NEMA ICS 1	Industrial Control and Systems General Requirements		
NEMA ICS 2	Industrial Control and Systems Controllers, Contractors, and Overload Relays Rated 600 Volts		
NEMA ICS 2 I	Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts		
NEMA ICS 2.3	Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts		
NEMA ICS 3	Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC		
NEMA ICS 3.1	Handling, Storage and Installation Guide for AC General Purpose Medium Voltage Contactors and Class E Controllers, 50 and 60 Hertz		
NEMA ICS 4	Application Guide for Terminal Blocks		
NEMA ICS 5	Control Circuit and Pilot Devices		
NEMA ICS 6	Industrial Control and Systems Enclosures		
NEMA ICS 6 I	Industrial Controls and Systems Enclosures		
NEMA ICS 7	Industrial Control and Systems: Adjustable-Speed Drives		
NEMA ICS 18	Industrial Control and Systems : Motor Control Centers		
NEMA ICS 2 I	Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts		
NEMA ICS 61800-4	Adjustable Speed Electrical Power Drive Systems Part 4: General Requirements – Rating Specifications for A.C. Power Drive Systems above 1000 V A.C. and Not Exceeding 35 kV		
NEMA KS 1	Enclosed and Miscellaneous Distribution Equipment Switches (600Volts Maximum)		
NEMA MG 1	Motor and Generators		
NEMA MG 2	Safety Standard and Guide for Selection, Installation, and Use of Electric Motors and Generators		
NEMA PB 1	Panel Boards		
NEMA PB-2	Deadfront Distribution Switchboards		
NEMA PE-1	Uninterruptable Power System (UPS) – Specification and Performance Verification		
NEMA PE 5	Utility Type Battery Chargers		
NEMA SG 4	Alternating-Current High-Voltage Circuit Breakers		
NEMA SM 23	Steam Turbines for Mechanical Drive Service		
NEMA SM 24	Land Based Steam Turbine Generator Sets 0 to 33,000 KW		
NEMA ST 20	Dry Type Transformers for General Applications		
NEMA TR 1 T	Transformers, Regulators and Reactors		
NEMA WC 5	Thermoplastic-Insulated Wire and Cable for Transmission and Distribution of Electrical Energy		
NEMA WC26	Bi-national Wire and Cable Packaging Standard		
NEMA VE-1	Metal Cable Tray Systems		
NEMA VE-2	Cable Tray Installation Guidelines		
NEMA WC57	Standard for Control, Thermocouple Extension, and Instrumentation Cables		



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NEMA WC70	Standard for Non-Shielded Power Cables Rated 2000 or Less for the Distribution of Electrical Energy		
NEMA WC71	Standard for Non-Shielded Power Cables Rated 2001-5000 Volts for Use in the Distribution of Electrical Energy		
NEMA WC74	5-46kV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy		
NEMA Z535-1	(ANSI) Z535-1 - Safety Colors		
NEMA Z535-2	(ANSI) Z535-2 - Environmental Facility and Safety Signs		
NEMA Z535-3	(ANSI) Z535-3 - Criteria for Safety Symbols		
NEMA Z535-4	(ANSI) Z535-4 - Product Safety Signs and Labels		
National Environmental Policy	Act (NEPA)		
NEPA	National Environmental Policy Act, Public Law 91 - 190		
National Fire Protection Associ	ation (NFPA)		
NFPA 10	Fire Extinguishers		
NFPA 11	Standard for Low-Medium and High Expansion Foam		
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems		
NFPA 13	Standard for the Installation of Sprinkler Systems		
NFPA 14	Standard for the Installation of Standpipe and Hose Systems		
NFPA 15	Standard for Water Spray Fixed Systems for Fire Protection		
NFPA 16	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems		
NFPA 17	Standard for Dry Chemical Extinguishing Systems		
NFPA 20	Standard for the Installation of Stationary Pumps for Fire Protection		
NFPA 22	Standard for Water Tanks for Private Fire Protection		
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances		
NFPA 25	Standard for Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems		
NFPA 30	Flammable and Combustible Liquids Code		
NFPA 37	Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines		
NFPA 45	Fire Protection for Laboratories Using Chemicals		
NFPA 58	Liquefied Petroleum Gas Code		
NFPA 59A-2001	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)		
NFPA 59A-2006	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG) (Seismic Loads)		
NFPA 59A-2013	Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)		
NFPA 70	National Electric Codes (NEC)		
NFPA 70E	Standard for Electrical Safety in the Workplace		
NFPA 72	National Fire Alarm and Signaling Code		
NFPA 75	Standard for the Fire Protection of Information Technology Equipment		



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<u>Standard</u>	<u>Description</u>		
NFPA 77	Recommended Practice on Static Electricity		
NFPA 80A	Recommended Practice for protection of Buildings from Exterior Fire Exposures		
NFPA 85	Boiler and Combustion System Hazards Code		
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems		
NFPA 101	Life Safety Code		
NFPA 110	Standard for Emergency and Standby Power Systems		
NFPA 251	Standard Methods of Tests of Fire Resistance of Building Construction and Materials		
NFPA 307	Standard for Construction and Fire Protection of Marine Terminals, Piers, and Wharves		
NFPA 496	Standards for Purged and Pressurized Enclosures for Electrical Equipment		
NFPA 497	Recommended Practice for the Classification of Flammable Liquids, Gases, Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas		
NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films		
NFPA 750	Standard on Water Mist Fire Protection Systems		
NFPA 780	Lightning Protection Systems		
NFPA 850	Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations		
NFPA 1961	Standard on Fire Hose		
NFPA 1965	Standard on Fire Hose Appliances		
NFPA 2001	Standard for Clean Agent Fire Extinguishing Systems		
National Oceanic and Atmospheric Administration (NOAA)			
NOAA Atlas 14, Volume 7, Version 2	Precipitation-Frequency Atlas of the United States, Volume 7 Version 2.0: Alaska		
Perlite Institute (PI)			
PI-201-77	Compacted Density		
Permanent International Assoc	iation of Navigation Congresses (PIANC)		
PIANC 2001	International Navigation Association, PIANC WG30 Guidelines		
Research Council on Structural	Connections (RCSC)		
RCSC-04	RCSC Specification for Structural Joints Using High-Strength Bolts		
Rivers and Harbors Act of 1899			
Society of International Gas Ta	nker and Terminal Operators Ltd (SIGTTO)		
SIGTTO	Recommendations and Guidelines for Linked Ship/Shore Emergency Shutdown of Liquefied Gas Cargo Transfer		
Steel Structures Painting Code	(SSPC)		
SSPC	Volumes 1 and 2		
SSPC AB 1	Mineral and Slag Abrasives		
SSPC AB 2	Cleanliness of Recycled Ferrous Metallic Abrasives		
SSPC AB 3	Newly Manufactured or Re-Manufactured Steel Abrasives		
SSPC GUIDE 15	Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates		



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<u>Standard</u>	<u>Description</u>				
SSPC PA 1	Shop, Field, and Maintenance Painting of Steel				
SSPC PA 2	Measurement of Dry Coating Thickness with Magnetic Gages				
SSPC QP 5	Standard Procedure For Evaluating Qualifications of Coating and Lining Inspection Companies				
SSPC SP 1	Solvent Cleaning				
SSPC SP 2	Hand tool Cleaning				
SSPC SP 3	Power Tool Cleaning				
SSPC SP 5	White Metal Blast Cleaning (NACE NO. 1)				
SSPC SP 6	Commercial Blast Cleaning				
SSPC SP 10	Near-White Metal Blast Cleaning (NACE NO. 2)				
SSPC SP 11	Power Tool Cleaning to Bare Metal				
SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning				
Telecommunications Industry	Association / Electronic Industries Alliance (TIA/EIA)				
TIA/EIA 222	Structural Standards for Steel Antenna Towers and Antenna Supporting Structures				
TIA/EIA 455	Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components Revision B				
TIA/EIA 492-AAAA-B	Detail Specification for 62.5-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers				
TIA/EIA 492-CAAA	Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers				
TIA-568-C	Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, Part 2: Balanced Twisted-Pair Cabling Components, and Part 3: Optical Fiber Cabling Components Standard - Includes: TIA-568-C.0, TIA-568-C.0-1, TIA-568-C.0-2, TIA-568-C.1, TIA-568-C.1-1, TIA-568-C.1-2, TIA-568-C.2, TIA-568-C.2 Errata, TIA-568-C.3, TIA-568-C.3-1, TIA-568-C.4				
Tubular Exchanger Manufactur	ers Association (TEMA)				
TEMA	Standards of the Tubular Echanger Manufacturers Association, (9th Edition) 2007				
Underwriter's Laboratory (UL)					
UL 1	Flexible Metal Conduit				
UL 4	Armored Cable				
UL 5	Safety Requirements for Surface Metal Raceways and Fittings				
UL 6	Electric Rigid Metal Conduit Steel				
UL 13	Standard for Safety – Power Limited Circuit Cables				
UL 44	Standard for Safety Thermoset-Insulated Wires and Cables				
UL 50	Standard for Safety Enclosures for Electrical Equipment, Non- Environmental Considerations				
UL 67	Standard for Safety for Panelboards				
UL 96A	Standard for Installation Requirements for Lightning Protection Systems				
UL 198L	Standard for DC Fuses for Industrial Use				
	Underwriters Laboratories Low-Voltage Fuses				



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<u>Standard</u>	<u>Description</u>		
UL 347	UL Standard for Safety High Voltage Industrial Control Equipment		
UL 467	Standard for Safety – Grounding and Bonding Equipment		
UL 489	UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures		
UL 498A	Current Taps and Adapters		
UL 508	Standard for Safety Industrial Control Equipment		
UL 508A	Industrial Control Panels		
UL 514B	Conduit, Cable, and Tubular Fittings		
UL 580	UL Standard for Safety, Standard for Tests for Uplift Resistance of Roof Assemblies		
UL 723	UL Standard for Safety, Standard for Tests for Surface Burning Characteristics of Building Materials		
UL 1805	Standard for Laboratory Hoods and Cabinets		
UL 845	Standard for Safety for Motor Control Centers		
UL 870	Wireways, Auxiliary Gutters, and Associated Fittings		
UL 886	Outlet Boxes and Fittings for Use in Hazardous Locations		
UL 924	Standard for Emergency Lighting and Power Equipment		
UL 1008	Standard for Safety Transfer Switch Equipment UL 1558 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear		
UL 1066	Low Voltage AC and DC Power Circuit Breakers Used in Enclosures		
UL 1072	Standard for Safety Medium-Voltage Power Cables		
UL 1277	Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members		
UL 1424	UL Standard for Safety - Cables for Power-Limited Fire-Alarm Circuits		
UL 1479	Standard for Safety Fire Tests Through-Penetration Fire-stop systems		
UL 1558	UL Standard for Safety Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear		
UL 1564	Standard for Industrial Battery Charger		
UL 1569	Standard for Safety Metal-Clad Cable UL 50 Underwriters Laboratories Enclosures and Boxes		
UL 1581	Reference Standard for Electrical Wires, Cables, and Flexible Cords		
UL 1604	Electrical Equipment For Use In Class I and II, Division 2 and Class III Hazardous Locations		
UL 1778	Standard for Uninterruptible Power Systems		
	a. Squirrel Cage Induction motors 800 HP (600 kW) and larger for 2 pole speed		
	Squirrel Cage Induction motors 3,000 HP (2,250 kW) and larger for 4, 6 and 8 pole speed		
	a. Squirrel Cage Induction motors from 250 HP (186 kW) and less than 3,000 HP (2250 kW) for 4, 6, and 8 pole speeds		
	b. Squirrel Cage Induction motors less than 800 HP (600 kW) for 2 pole speed		
	c. Squirrel Cage Induction motors less than 1,250 HP (930 kW) for WPII enclosure for 2 pole speed		



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<u>Standard</u>	<u>Description</u>		
United States Code (USC)			
16 USC Section 668-668d	Bald and golden eagles		
16 USC Section 703-712	ligratory Bird Treaty Act		
16USC Section 1371	Moratorium on taking and importing marine mammals and marine mammal products		
16 USC Section 1431	Findings, purposes, and policies; establishment of system		
16 USC Section 1531-1544	Endangered Species Act, Section 7		
16 USC Section 1801	Magnuson-Stevens Fishery Conservation and Management Act / Sustainable Fisheries Act US Coast Guard		
33 USC Section 9	Rivers and Harbors Act of 1899		
33 USC Section 403	Obstruction of navigable waters generally; wharves; piers, etc.; excavations and filling in		
33 USC Section 1251	Federal Water Pollution Control		
33 USC Section 1271	Sediment survey and monitoring		
33 USC Section 1342	National Pollutant Discharge Elimination System		
33 USC Section 1344	Permits for Dredging		
42 USC Section 4321-4327	Council on Environmental Quality		
42 USC Section 6901	Solid Waste Disposal Act		
42 USC Section 7401	Congressional findings and declaration of purpose1		
47 USC Section 151	Purposes of chapter; Federal Communications Commission created		
49 U.S.C. Chapter 601	Safety (DOT PHMSA)		
49 U.S.C. Chapter 603	User Fees (DOT PHMSA)		
N/A	Pipeline Inspection, Protection, Enforcement and Safety Act of 2006 (DOT PHMSA)		
United States Code, 2006 Edition, Supplement 5, Title 47	Telegraphs, Telephones, and Radiotelegraphs; Federal Communications Commission Created		
U.S. Department of Commerce,	Weather Bureau		
U.S. Department of Commerce, Weather Bureau, Technical Paper No. 47	Probable Maximum Precipitation		
U.S. Fish & Wildlife Service			
N/A	U.S. Fish & Wildlife Service Land Clearing Timing Guidance for Alaska		

Alaska LNG



ALASKA LNG PROJECT – LIQUEFACTION FACILITY

EPC CONTRACTOR DESIGN CODES AND STANDARDS (LNG TERMINAL)

AKLNG-4030-VVV-SPC-DOC-00001



ALASKA LNG PROJECT – LIQUEFACTION FACILITY

EPC CONTRACTOR DESIGN CODES AND STANDARDS (LNG TERMINAL)

Prepared for:



Prepared by:



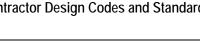
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ISSUE PURPOSE:	For Client Review		
DATE:	03/28/17		
BY:	BLG		
CHECKED:	PJS		
APPROVED:	PJS		

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1 OVERVIEW

This document lists the codes and standards applicable to the Project. The most relevant and mandatory codes, regulations and standards applicable to the design are as follows:

- ◆ 49 CFR Part 193: Liquefied Natural Gas Facilities Federal Safety Standards,
- NFPA 59A, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG). Applicable editions of this Standard are incorporated in 49 CFR 193 (per § 193,2013), and

Other codes and standards that may be used in the design, construction and operation of the Project, as applicable, are listed in the following section of this document. All applicable local codes and standards that have not been included in the list shall be satisfied in the design.

For each code and standard not referenced by 49 CFR 193 or NFPA 59A (as incorporated by 49 CFR 193), the current/latest version available should be used for design of the Project, unless approved by Owner.

Where there is a conflict between an international standard and a local one, the most stringent requirements shall apply.

As it applies to purchased equipment and packaged/skidded systems, this document lists codes and standards recommended for consideration by the designers of structures, buildings, electrical, controls, systems and equipment to be used in the design. In those cases, the designer may choose other equivalent internationally recognized codes and standards to be used, as approved by the owner.

2 CODES AND STANDARDS FOR MARINE FACILITIES

2.1 American Petroleum Institute (API)

- RP 2A-WSD, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms-Working Stress Design, with Errata and Supplement 2
- RP 1124, Ship, Barge, and Terminal Hydrocarbon Vapor Collection Manifolds
- RP 1140, Guidelines for Developing Bridge Management Teams
- API, Quantified Hazard Evaluation of Marine Vapor Recovery Systems
- API SPEC 5L, Specification for Line Pipe

2.2 Code of Federal Regulations

- 33 CFR Part 105, USCG, Department of Homeland Security, Maritime Security (Facility) Regulations
- 33 CFR Part 126, Handling of Class 1 (Explosive) Materials or Other Dangerous Cargoes Within or Contiguous to Waterfront Facilities



• 33 CFR Part 127, Waterfront Facilities Handling Liquefied Natural Gas and Liquefied Hazardous Gas

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- 33 CFR Part 149, Deep Water Ports: Design, Construction and Equipment
- 33 CFR Part 154, Facilities Transferring Oil or Hazardous Material in Bulk
- 33 CFR Part 156, Oil and Hazardous Material Transfer Operations

International Association of Lighthouse Authorities (IALA) 2.3

- NP 735, IALA Maritime Buoyage System
- Aid to Navigation Review

2.4 **International Maritime Organization (IMO)**

- IMO-290E, Recommendations on the Safety Transport of Dangerous Cargoes and Related Activities in Port Areas
- IMO-520E. Marine Pollution, MARPOL, Consolidated Edition

Marine Oil Terminals (MOTEMS) 2.5

- MOTEMS Section 3103F.2, Dead Loads
- MOTEMS Table 31F-3-2, Equipment and Piping Area Loads
- MOTEMS Section 3103F.4, Earthquake Loads
- MOTEMS Section 3103F.5, Mooring Loads
- MOTEMS Section 3103F.4, Earthquake Loads
- MOTEMS Section 3103F.6, Berthing Loads
- MOTEMS Section 3103F.7, Wind and Current Loads on Structures
- MOTEMS Section 3103F.8, Load Combinations
- MOTEMS Section 3103F.9 and 3103F.10, Mooring Lines and Hardware Safety Factors and Allowable Loads
- MOTEMS Section 3104F, Seismic Analysis and Structural Performance
- MOTEMS Section 3105F, Mooring and Berthing Analysis and Design
- MOTEMS Section 3107F, Structural Analysis and Component Design

Oil Companies International Marine Forum (OCIMF) 2.6

- Guide on Marine Terminal Fire Protection and Emergency Evacuation
- Safety Guide for Terminals Handling Ships Carrying Liquefied Gases in Bulk
- Mooring Equipment Guidelines
- ISGOTT, International Safety Guide for Oil Tankers and Terminals
- Prediction of Wind Loads on Large Liquefied Gas Carriers
- Design and Construction Specification for Marine Loading Arms

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- A Guide to Contingency Planning for the Gas Carrier Alongside and Within Port Limits
- Guidelines and Recommendations for the Safe Mooring of Large Ships at Piers and Sea Islands
- Prediction of Wind and Current Loads on VLCCs
- Recommendations for Manifolds for Refrigerated Liquefied Natural Gas Carriers (LNG)

2.7 Society of International Gas Tanker and Terminal Operators (SIGTTO)

- Liquefied Gas Handling Principles on Ships and in Terminals
- A Guide to Contingency Planning for Marine Terminals Handling Liquefied Gases in Bulk
- Accident Prevention The use of Hoses & Hard-Arms
- Site Selection and Design for LNG Ports and Jetties, Information Paper No. 14,
- Guide to Marine Terminal Fire Protection and Emergency Evacuation

2.8 PIANC and U.S.A.C.E. Standards for Deep Draft Navigation Standards

- Dangerous Goods in Ports: Recommendations for Port Designers and Port Operators, Permanent International Association of Navigation Congresses (PIANC)
- Guidelines for the Design of Fenders Systems, Permanent International Association of Navigation Congresses (PIANC)

2.9 Modified U.S.C.G. Regulations for LNG Navigation Regulations

2.10 United States Department of Defense

Military Handbook, Piers and Wharfs, MIL-HDBK-1025/1

3 CODES AND STANDARDS FOR ON-SHORE FACILITIES

3.1 American Concrete Institute

- ACI 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
- ACI 301, Specifications for Structural Concrete
- ACI 304R, Guide for Measuring, Mixing, Transportation and Placing Concrete
- ACI 305R, Hot Weather Concreting
- ACI 306R, Cold Weather Concreting,
- ACI 308.1, Standard Specification for Curing Concrete,
- ACI 311.4R, Guide for Concrete Inspection
- ACI SP 66, Detailing Manual



- ACI 318, Building Code Requirements for Structural Concrete and Commentary
- ACI 350, Code Requirements for Environmental Engineering Concrete Structures
- ACI 372R, Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures
- ACI 373R, Design and Construction of Circular Prestressed Concrete Structures with Circumferential Tendons
- ACI 376, Code Requirement for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases and Commentary
- ACI 506.2, Specifications for Shotcrete

3.2 **American Gas Association**

- AGA Report No. 3, Orifice Metering of Natural Gas Parts 1, 2, 3, and 4
- AGA Report No. 5, Fuel Gas Energy Metering Report
- AGA Report No. 7, Measurement of Natural Gas by Turbine Meter
- AGA Report No. 8, Compressibility Factor of Natural Gas and Related Hydrocarbon Gases
- AGA Report No. 9, Measurement of Gas by Multipath Ultrasonic Meters
- Operating Section Report, Purging Principles and Practice

American Institute of Steel Construction (AISC) 3.3

- AISC 341-05 with supplement 1, Seismic Provisions for Structural Steel Buildings
- AISC, Steel Construction Manual
- AISC, "Load Resistance Factor Design Manual of Steel Construction"
- AISC, RCSC Specification for Structural Joints Using High Strength Bolts

American National Standard Institute (ANSI) 3.4

- ANSI/ASA S3.41, Audible Emergency Evacuation Signal
- ANSI/ASSE Z117.1, Safety Requirements for Confined Spaces
- ANSI/AWWA C200, Steel Water Pipe 6 in. and Larger
- ANSI/ISEA Z358.1, American National Standard for Emergency Eyewash and Shower Equipment

3.5 **American Petroleum Institute (API)**

- API SPEC 2B, Specification for the Fabrication of Structural Steel Pipe
- API SPEC 5L, Specification for Line Pipe



- API SPEC 6D, Specification for Pipeline Valves
- API 11.2.2, Compressibility Requirements for Hydrocarbon 0.350-0-637 Relative Density and -50 Degrees F to 140 Degrees F Metering Temperature
- API MPMS Chapter 14.3 P1, Natural Gas Fluid Measurement Concentric, Square-edged Orifice Meters Part 1: General Equations and Uncertainty Guidelines
- API RP 500, Recommended Practice for Classification of Locations for Electrical Installation at Petroleum Facilities Classified as Class I, Division 1 and Division 2
- API RP 505 Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2
- API RP 520 Part 1, Sizing, Selection and Installation of Pressure Relieving Devices in Refineries, Part 1-Sizing and Selection
- API RP 520 Part 2, Sizing, Selection and Installation of Pressure Relieving Devices in Refineries, Part 2-Installation
- API RP 521, Guide for Pressure-Relieving and Depressuring Systems
- API 526, Flanged Steel Safety Relief Valves for Flanged Pressure Relief Valves
- API 527, Seat Tightness of Safety Relief Valves
- API RP 540, Recommended Practice for Electrical Installation in Petrochemical Process Plants
- API 546, Brushless Synchronous Motors 500 kVA and Larger
- API RP 551, Process Measurement Instrumentation
- API 600, Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries
- API 602, Steel Gate, Globe and Check Valves for Sizes DN 100 and Smaller for the Petroleum and Natural Gas Industries
- API 610, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
- API 613, Special-Purpose Gear Units for Petroleum, Chemical and Gas Industry Services
- API 614, Lubrication, Shaft-Sealing, and Control-Oil systems and Auxiliaries for Petroleum, Chemical and Gas Industry Services
- API 617, Axial and Centrifugal Compressors and Expander-Compressors for Petroleum, Chemical, and Gas Industry Services
- API 618, Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services
- API 619, Rotary-Type Positive Displacement Compressors for Petroleum, Chemical and Gas Industry Services

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- API 620, Design and Construction of Large, Welded, Low-pressure Storage Tanks
- API 650, Welded Steel Tanks for Oil Storage
- API 661, Air-Cooled Heat Exchangers for General Refinery Services
- API 670, Machinery Protection Systems
- API 671, Special Purpose Couplings for Petroleum, Chemical and Gas Industry Services
- API 672, Packaged, Integrally Geared, Centrifugal Air Compressors for Petroleum, Chemical and Gas Industry Services
- API 682, Pumps—Shaft Sealing Systems for Centrifugal and Rotary Pumps
- API RP 752, Management of Hazards Associated with Location of Process Plant Buildings
- API 2001, Fire Protection in Refinerie
- API RP 2003, Recommended Practice for Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents
- API 2510, Design and Construction of Liquefied Petroleum Gas (LPG) Installations
- API 2510A, Fire-Protection Considerations for the Design and Operation of Liquefied Petroleum Gas Storage Facilities

3.6 American Society of Civil Engineers (ASCE)

ASCE 7, Minimum Design Loads for Buildings and Other Structures

3.7 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

- ASHRAE Handbook Fundamentals
- ASHRAE Handbook HVAC Systems & Equipment
- ASHRAE Handbook HVAC Applications

3.8 The American Society of Mechanical Engineers (ASME)

- ASME B16.20, Metallic Gaskets for Pipe Flanges—Ring-Joint, Spiral-Wound and Jacketed
- ASME B16.47, Large Diameter Steel Flanges, NPS 26 Through NPS 60 Metric/Inch Standard
- ASME Boiler and Pressure Vessel Code, and Boiler and Pressure Vessel Code including all mandatory addenda
- Section I, Rules for Construction of Power Boilers
- · Section II, Materials
- Section IV, Heating Boilers

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- Section V, Non-Destructive Examination
- Section VII, Pressure Vessels
- Section VIII, Rules for the Construction of Pressure Vessels, Divisions I and II
- Section IX, Welding and Brazing Qualifications
- ASME A13.1, Scheme for the Identification of Piping Systems
- ASME B1.20.1, Pipe Threads General Purpose (Inch)
- ASME B16.3, Malleable Iron Threaded Fittings
- ASME B16.5, Pipe Flanges and Flanged Fittings—NPS ½ through 24
- ASME B16.10, Face to Face and End to End Dimensions of Valves
- ASME B16.11, Forged Fittings, Socket-Welding and Threaded
- ASME B16.20, Metallic Gaskets for Pipe Flanges: Ring Joint, Spiral Wound and Jacketed
- ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges
- ASME B16.47, Large Diameter Steel Flanges
- ASME B31.3, Process Piping
- ASME B31.5, Refrigeration Piping and Heat Transfer Components
- ASME B31.8, Gas Transmission and Distribution Piping Systems
- ASME B73.1, Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process
- ASME B73.2, Specification for Vertical In-line Centrifugal Pumps for Chemical Process
- ASME PTC-10, Test Code on Compressors & Exhausters

3.9 American Society for Non-Destructive Testing (ASNT)

- SNT-TC-1A, Recommended Practice for Non-Destructive Testing Personnel Qualification and Certification
- ASNT 2504, Standard for Qualification and Certification of Nondestructive Testing Personnel

3.10 American Society for Testing and Materials (ASTM)

ASTM material specifications will be used unless otherwise specified. Below is a partial listing of ASTM material specifications that may be used:

- ASTM A36, Carbon Structural Steel
- ASTM A53, Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
- ASTM A74, Cast Iron Soil Pipe and Fittings
- ASTM A105, Carbon Steel Forgings for Piping Applications

- ASTM A106, Seamless Carbon Steel Pipe for High-Temperature Service
- ASTM A123, Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A153, Zinc Coating (Hot Dip) on Iron and Steel Hardware
- ASTM A167, Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- ASTM A181, Carbon Steel Forgings, for General Purpose Piping
- ASTM A185, Steel Welded Wire Reinforcement, Plain, for Concrete
- ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
- ASTM A194, Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
- ASTM A203, Pressure Vessel Plates, Alloy Steel, Nickel
- ASTM A216, Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service
- ASTM A249, Welded Austenitic Steel Boiler, Superheater, Heat- Exchanger, and Condenser Tubes
- ASTM A307, Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength
- ASTM A312, Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes
- ASTM A320, Alloy-Steel Bolting Materials for Low-Temperature Service
- ASTM A325, Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- ASTM A333, Seamless and Welded Steel Pipe for Low-Temperature Service
- ASTM A351, Castings, Austenitic, for Pressure-Containing Parts
- ASTM A353, Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double-Normalized and Tempered
- ASTM A403, Wrought Austenitic Stainless Steel Piping Fittings
- ASTM A416, Steel Strand, Uncoated Seven Wire for Prestressed Concrete
- ASTM A420, Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
- ASTM A421, Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
- ASTM A463, Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
- ASTM A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
- ASTM A490, Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength



- ASTM A516, Pressure Vessel Plates, Carbon Steel, for Moderate and Lower-Temperature Service
- ASTM A522, Forged or Rolled 8% and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low Temperature Service
- ASTM A541, Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
- ASTM A553, Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8% and 9% Nickel
- ASTM A563, Carbon and Alloy Steel Nuts
- ASTM A615, Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A673, Sampling Procedure for Impact Testing of Structural Steel
- ASTM A706, Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
- ASTM A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coating
- ASTM B209, Aluminum and Aluminum Alloy Sheet and Plate
- ASTM C33, Concrete Aggregates
- ASTM C94, Ready-Mixed Concrete
- ASTM C260, Air-Entraining Admixtures for Concrete
- ASTM C450, Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
- ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation
- ASTM C552, Cellular Glass Thermal Insulation
- ASTM C585, Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)
- ASTM C591, Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
- ASTM C871, Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
- ASTM D75, Standard Practice for Sampling Aggregates
- · ASTM D422, Test Method for Particle-Size Analysis of Soils
- ASTM D698, Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
- ASTM D1241, Materials for Soil-Aggregate Subbase, Base, and Surface Courses
- ASTM D1557, Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort

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- ASTM D2665, PolyVinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- ASTM D4945, High-strain Dynamic Testing of Piles
- ASTM D6938, Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36,55, and 105 ksi Yield Strength

3.11 American Welding Society (AWS)

- AWS A2.1, Welding Symbol Charts,
- AWS A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- AWS A5.1, Carbon Steel Electrodes for Shielded Metal Arc Welding
- AWS A5.17, Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
- AWS A5.5, Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
- AWS D1.1, Structural Welding Code, Steel
- AWS D1.4, Structural Welding Code, Reinforcing Steel

3.12 Center for Chemical Process Safety (CCPS)

Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires.

3.13 Code of Federal Regulations

- 49 CFR Part 191, Transportation of Natural and Other Gas by Pipeline, Annual Reports, Incident Reports, and Safety-Related Condition Reports,
- 49 CFR 192, Transportation of Natural Gas and Other gas by Pipeline: Federal Safety Standards,
- 49 CFR 193, Liquefied Natural Gas Facilities Federal Safety Standards

3.14 Concrete Reinforcing Steel Institute (CRSI)

- · CRSI Manual of Practice
- CRSI 63, Recommended Practice for Placing Reinforcing Bars
- CRSI 65, Recommended Practice for Placing Bar Supports, Specification and Nomenclature

3.15 Expansion Joint Manufacturers Association (EJMA)

Standards of the Expansion Joint Manufacturers Association, Inc.



3.16 FEMA Publication

FEMA-302, NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures

3.17 Gas Processors Association (GPA)

- GPA 2145, Table of Physical Constants for the Hydrocarbons and Other Compounds of Interest to the Natural Gas Industry
- GPA 2166, Obtaining Natural Gas Samples for Analysis by Gas Chromatography
- GPA 2172, Calculation of Gross Heating Value, Relative Density and Compressibility Factor for Natural Gas Mixtures for Compositional Analysis
- GPA 2261, Analysis for Natural gas and Similar Gaseous Mixtures by Gas Chromatography

3.18 Gas Technology Institute (GTI)

• GTI Report 04/0032, LNGFIRE3: A Thermal Radiation Model for LNG Fires

3.19 GE Global Asset Protection (GE GAP)

GE GAP 2.5.2, Oil and Chemical Plant Layout and Spacing

3.20 International Code Council (ICC)

International Building Code

3.21 Institute of Electrical and Electronic Engineers (IEEE)

- IEEE C2, National Electrical Safety Code
- IEEE C37, Circuit Breakers, Switchgear, Relays, Substations, and Fuses. Institute of Electrical and Electronics Engineers
- IEEE C37.20.2, Standard for Metal Clad Switchgear
- IEEE C37.20.7, Guide for Testing Metal Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults
- IEEE 80, Guide for Safety in Substation Grounding
- IEEE 97, Recommended Practice for Specifying Service Condition in Electrical Standards
- IEEE-C57.12.00, Standard General Requirements for Liquid Immersed Distribution, Power and Regulating Transformers
- IEEE C57.12.01, Standard General Requirements for Dry Type Distribution and Power Transformers
- IEEE C57.12.90, Liquid Immersed Distribution, Power and Regulating Transformers and Guide for Short Circuit Testing of Distribution and Power Transformers

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- IEEE Std. 141, Recommended Practice for Electric Power Distribution for Industrial Plants (Red Book)
- IEEE Std. 142, Recommended Practice for Grounding of Industrial and Commercial Power System (Green Book)
- IEEE Std. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book)
- IEEE Std. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book)
- IEEE Std. 446, Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (Orange Book)
- IEEE Std. 493, Recommended Practice for Design of Reliable Industrial and Commercial Power Systems (Gold Book)

3.22 International Electrotechnical Commission (IEC)

- IEC 60534-1, Industrial Process Control Valves, Control Valve Terminology and general Considerations
- IEC 60534-2-1, Industrial Process Control Valves Part 2-1
- IEC 60534-2-3, Industrial Process Control Valves Part 2-3
- IEC 60534-2-4, Industrial Process Control Valves Part 2-4
- IEC 60534-3-1, Industrial Process Control Valves Part 3-1
- IEC 60534-3-2, Industrial Process Control Valves Part 3-2
- IEC 60534-3-3, Industrial Process Control Valves Part 3-3
- IEC 60534-4, Industrial Process Control Valves Part 4
- IEC 60534-5, Industrial Process Control Valves Part 5
- IEC 60534-6-1, Industrial Process Control Valves Part 6-1
- IEC 60534-8-2, Industrial Process Control Valves Part 8-2
- IEC 60534-8-3, Industrial Process Control Valves Part 8-3
- IEC 61131-1, Programmable Controllers General
- IEC 61508, Functional Safety of Electrical/Electronic Programmable Electronic Safety Related Systems
- IEC 61511, Functional Safety Safety Instrumented Systems for the Process Industry Sector

3.23 The International Society of Automation (ISA)

- ISA RP3.2, Flange Mounted Sharp Edged Orifice Plates for Flow Measurement
- ISA 5.1, Instrumentation Symbols and Identification
- ISA 5.2, Binary Logic Diagrams for Process Operations

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- ISA 5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems
- ISA 5.4, Instrument Loop Diagrams
- ISA 5.5 Graphic Symbols for Process Displays
- ISA 12.13 Part I, Performance Requirements for Combustible Gas Detectors
- ISA 12.13 Part II, Installation, Operation and Maintenance of Combustible Gas Detectors
- ISA 18.1, Annunciator Sequences and Specifications
- ISA MC96.1, Temperature Measurement Thermocouples
- ISA RP 2.1, Manometer Table
- ISA RP 12.1, Electrical Instruments in Hazardous Atmospheres
- ISA RP 12.4, Instrument Purging for Reduction of Hazardous Area Classification
- ISA RP 12.6, Wiring Practices for Hazardous (Classified) Locations Instrumentation – Part 1 Intrinsic Safety
- ISA RP 12.12.03 Recommended Practice for Portable Electronic Products Suitable for Use in Class I and II Division 2, Class I, Zone 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
- ISA RP 60.1, Recommended Practice for Control Center Facilities
- ISA RP 60.3, Human Engineering for Control Centers
- ISA RP 60.4, Documentation for Control Centers
- ISA RP 60.6, Nameplates, Labels, and Tags for Control Centers
- ISA 20, Specification Forms
- ISA 75.01.01, Flow Equation for Sizing Control Valves
- ISA 84.01, Application of Safety Instrumented Systems for the Process Industry

3.24 International Standards Organization (ISO)

ISO10474 "Steel and Steel Products – Inspection Documents"

3.25 Manufacturer's Standardization Society (MSS)

- MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions
- MSS SP44, Steel Pipeline Flanges
- MSS SP53, Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
- MSS SP54, Standard Specification for Steel Castings for Valves, Flanges and Other Piping Components – Radiographic Examination Method

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- MSS SP-55, Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components – Visual Method for Evaluation of Surface Irregularities
- MSS SP-67, Butterfly Valves
- MSS SP-68, High Pressure Offset Seat Butterfly Valves
- MSS SP-93, Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components – Liquid Penetrant Examination Method
- MSS SP-94, Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components – Ultrasonic Examination Method

3.26 National Association of Corrosion Engineers (NACE)

- NACE RP 01 69, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- NACE SP 0187, Design Consideration for Corrosion Control of Reinforcing Steel in Concrete Structure
- NACE SP 0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
- NACE SP 0198, Control of Corrosion Under Thermal Insulation and Fireproofing Materials—A Systems Approach

3.27 National Electrical Manufacturers Association (NEMA)

- NEMA IBU 1, Busways
- NEMA ICS 16, Industrial Control and Systems Motion/Position Control Motors Controls and Feedback Devices
- NEMA ICS1, Industrial Control and Systems: General Requirements
- NEMA ICS2, Industrial Control and System Controllers Contactors and Overload Relays Rated 600 Volts
- NEMA IA 2.1, Programmable Controllers
- NEMA ICS 6, Enclosures for Industrial Control and Systems
- NEMA 250, Enclosures for Electrical Equipment 1000 Volts Maximum
- NEMA MG1, Motors and Generators
- NEMA MG2, Safety Standard and Guide for Selection, Installation, and Use of Electric Motors and Generators
- NEMA SG 5, Power Switchgear Assemblies
- NEMA TR 1, Transformers, Regulators and Reactors
- NEMA TR 27, Commercial, Institutional and Industrial Dry-Type Transformers

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- NEMA WC 5, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- NEMA WC 25, Protective Coverings for Wire and Cable Reels
- NEMA WC 26/EEMAC 201, Binational Wire and Cable Packaging Standard
- NEMA WC 70/ICEA S-95-658, Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy
- NEMA WC 71/ICEA C-96-659, Standard for Non-Shielded Cables Rated 2,001-5,000 Volts for Use in the Distribution of Electric Energy
- NEMA WC 74/ICEA S-93-639, 5 to 46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

3.28 National Fire Protection Association (NFPA)

- NFPA 10, Standard for Portable Fire Extinguishers
- NFPA 11, Standard for Low-, Medium-, and High-Expansion Foam
- NFPA 12, Standards for Carbon Dioxide Extinguishing System
- NFPA 13, Standard for Installation of Sprinkler Systems
- NFPA 14, Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems
- NFPA 15, Water Spray Fixed Systems
- NFPA 17, Standard for Dry Chemical Extinguishing Systems
- NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection
- NFPA 22, Standard for Water Tanks for Private Fire Protection
- NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances
- NFPA 25, Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems
- NFPA 30, Flammable and Combustible Liquids Code
- NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2010
- NFPA 54, National Fuel Gas Code
- NFPA 55, Compressed Gases and Cryogenic Fluids Code
- NFPA 58, Liquefied Petroleum Gas Code
- NFPA 59, Utility LP-Gas Plant Code
- NFPA 59A, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)
- NFPA 68, Standard on Explosion Protection by Deflagration Venting
- NFPA 69, Standard on Explosion Prevention Systems

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- NFPA 70, National Electrical Code
- NFPA 70E, Electrical Safety in Work Place
- NFPA 72, National Alarm Code
- NFPA 77, Recommended Practice on Static Electricity
- NFPA 90A Standard for Installation of Air-Conditioning and Ventilating Systems
- NFPA 101, Life Safety Code
- NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials
- NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment
- NFPA 497, Recommended Practice for the Classification of Flammable Liquids, Gases or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
- NFPA 600, Standard for Industrial Fire Brigades
- NFPA 750, Water Mist Fire Protection Systems
- NFPA 780, Standard for the Installation of Lightning Protection Systems
- NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
- NFPA 1901, Standard for Automotive Fire Apparatus
- NFPA 1961, Standard on Fire Hose
- NFPA 1962, Standard for the Inspection, Care, Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose
- NFPA 1963, Standard for Fire Hose Connections
- NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

3.29 National Institute of Standards and Technology (NIST)

The following standard shall be incorporated in the design, as it applies to specific state authorities:

NIST Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

3.30 National Safety Council (NSC)

NSC Z117.1, Safety Requirements for Confined Spaces

3.31 Sheet Metal & Air Conditioning Contractors National Association (SMACNA)

SMACNA HVAC Duct Construction Standards - Metal and Flexible



3.32 Steel Structures Painting Council (SSPC)

- SSPC PA 1, Shop, Field and Maintenance Painting of Steel
- SSPC PS 8.01, Rust Preventive Compounds (Thick Film) Compound
- SSPC PT 3, Basic Zinc Chromate Vinyl Butyral Washcoat
- SSPC SP 1, Solvent Cleaning
- SSPC SP 2, Hand Tool Cleaning
- SSPC SP 3, Power Tool Cleaning
- SSPC SP 5, White Metal Blast Cleaning
- SSPC SP 6, Commercial Blast Cleaning
- SSPC SP 7, Brush Off Blast Cleaning
- SSPC SP 8, Pickling
- SSPC SP 10, Near-White Blast Cleaning

3.33 Tubular Exchanger Manufacturers Association (TEMA)

TEMA, Standards of the Tubular Exchanger Manufacturers Association

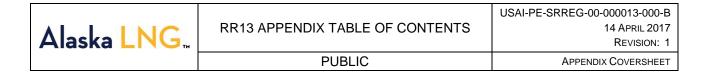
3.34 Underwriters Laboratories (UL)

- UL 1, Flexible Metal Conduit
- UL 4, Armored Cable
- UL 5, Surface Metal Raceways and Fittings
- UL 6, Electrical Rigid Metal Conduit Steel
- UL 44, Thermoset-Insulated Wires and Cables
- · UL 50, Enclosures for Electrical Equipment
- UL 67, Standard for Panelboards
- UL 464, Audible Signal Appliances
- UL 467, Grounding and Bonding Equipment
- UL 498, Attachment Plugs and Receptacles
- UL 508, Standard for Industrial Control Equipment
- UL 514, Fittings for Conduit and Outlet Boxes
- UL 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations
- UL 823, Electric Heaters for Use in Hazardous (Classified) Locations
- UL 844, Luminaries for Use in Hazardous (Classified) Locations
- UL 857, Busways
- UL 870, Wireways, Auxiliary Gutters, and Associated Fittings

Alaska LNG EPC Contractor Design Codes and Standards (LNG Terminal)

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- UL 924, Standard for Emergency Lighting and Power Equipment
- UL 1203, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations



APPENDIX 13E - ENGINEERING DESIGN INFORMATION

E.1 – Block Diagram of Facilities

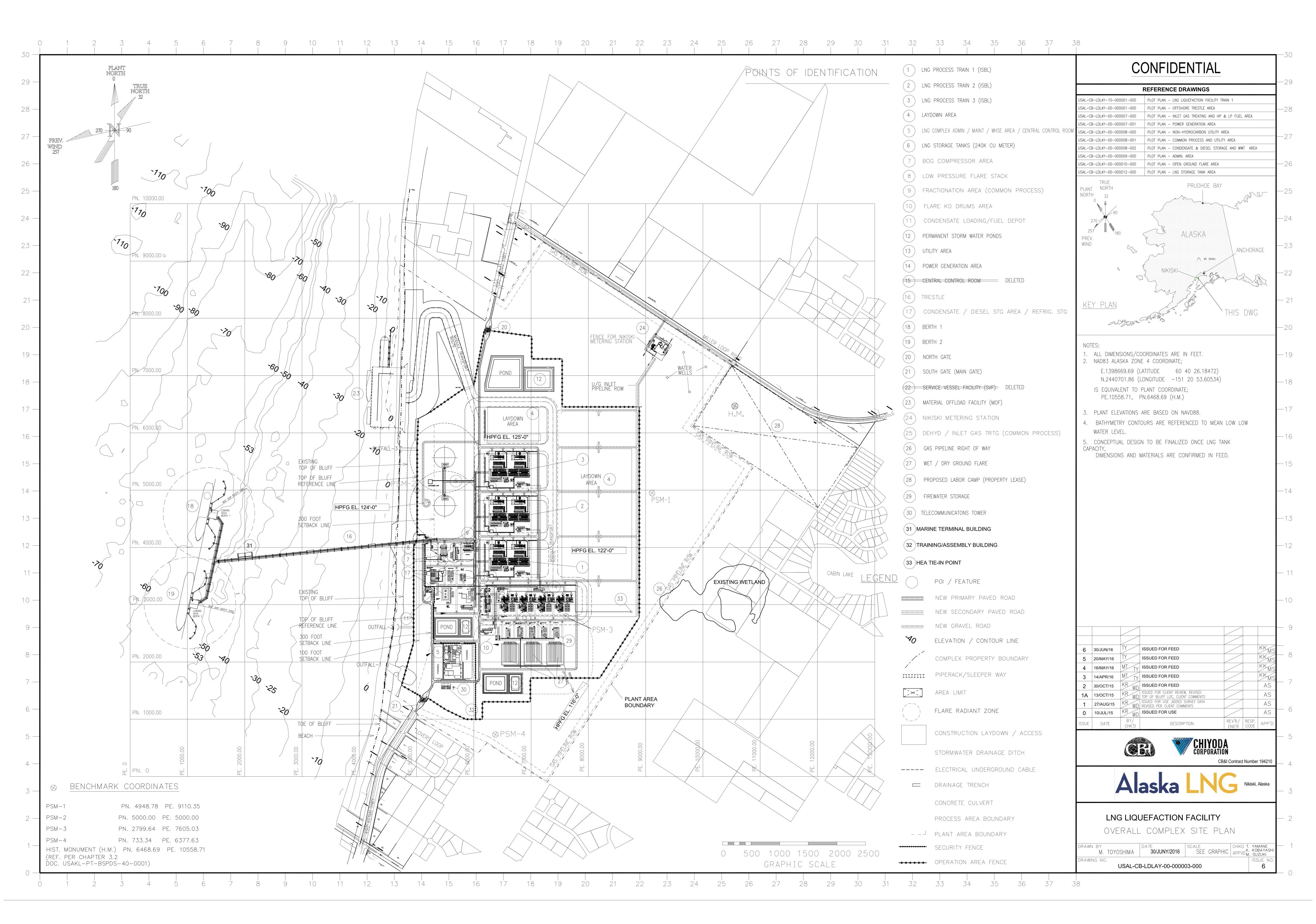
Document Number:	Description:	Revision:	Appendix:
N/A	Refer to E.2, Process Flow Diagrams	N/A	Public



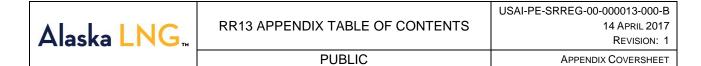
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E.6 – Plant and Equipment Layouts

Document Number:	Description:	Revision:	Appendix:
USAL-CB-LDLAY-00-000003-000	LNG Liquefaction Facility Overall Complex Site Plan	Rev 6	Public
USAL-CB-CDTOP-00-000057-001	Civil Site Topographical Plan Layout	Rev 1	Public







E.7 – Plant Reliability, Availability, and Maintainability (RAM) Analyses*

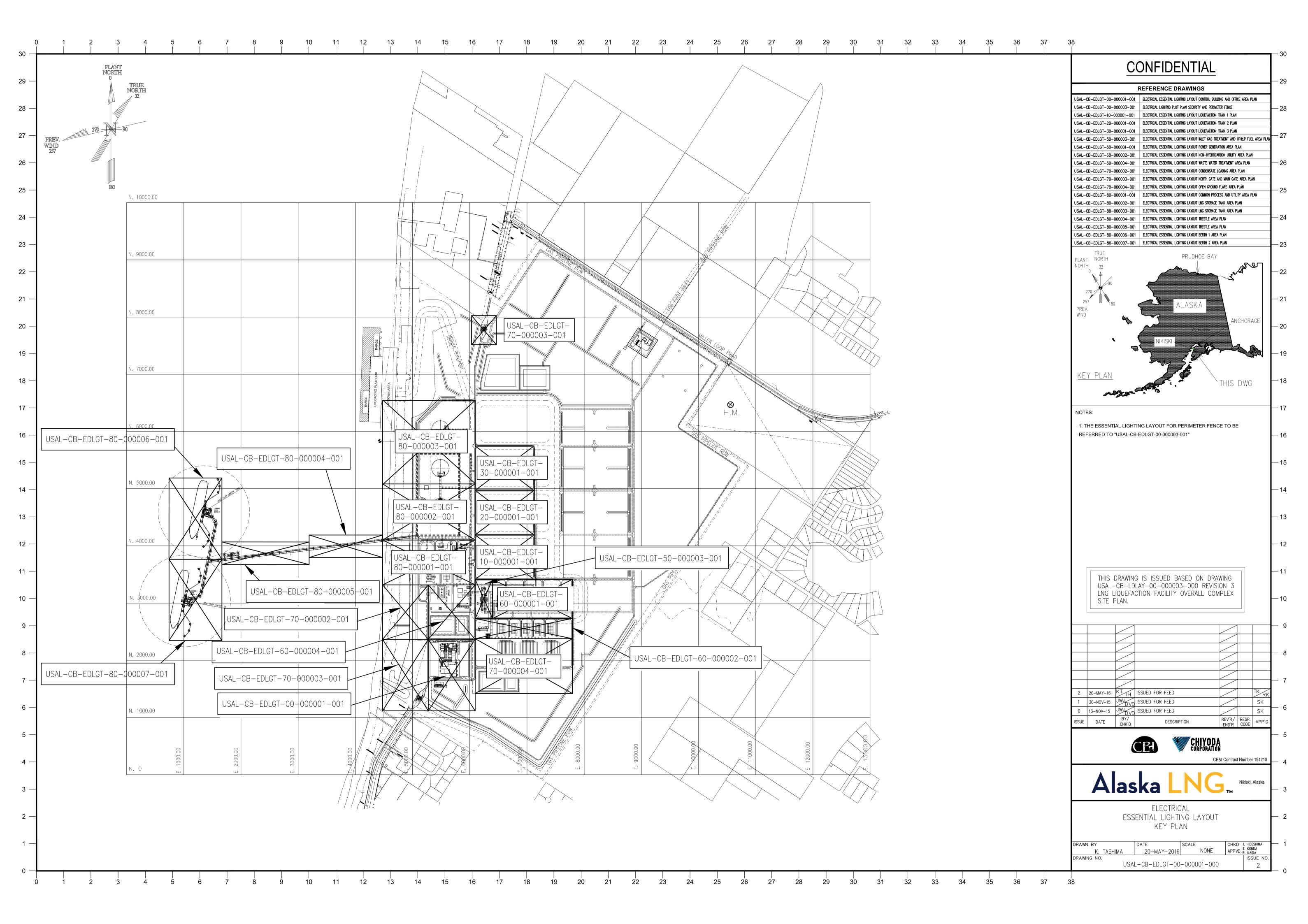
Document Number:	Description:	Revision:	Appendix:
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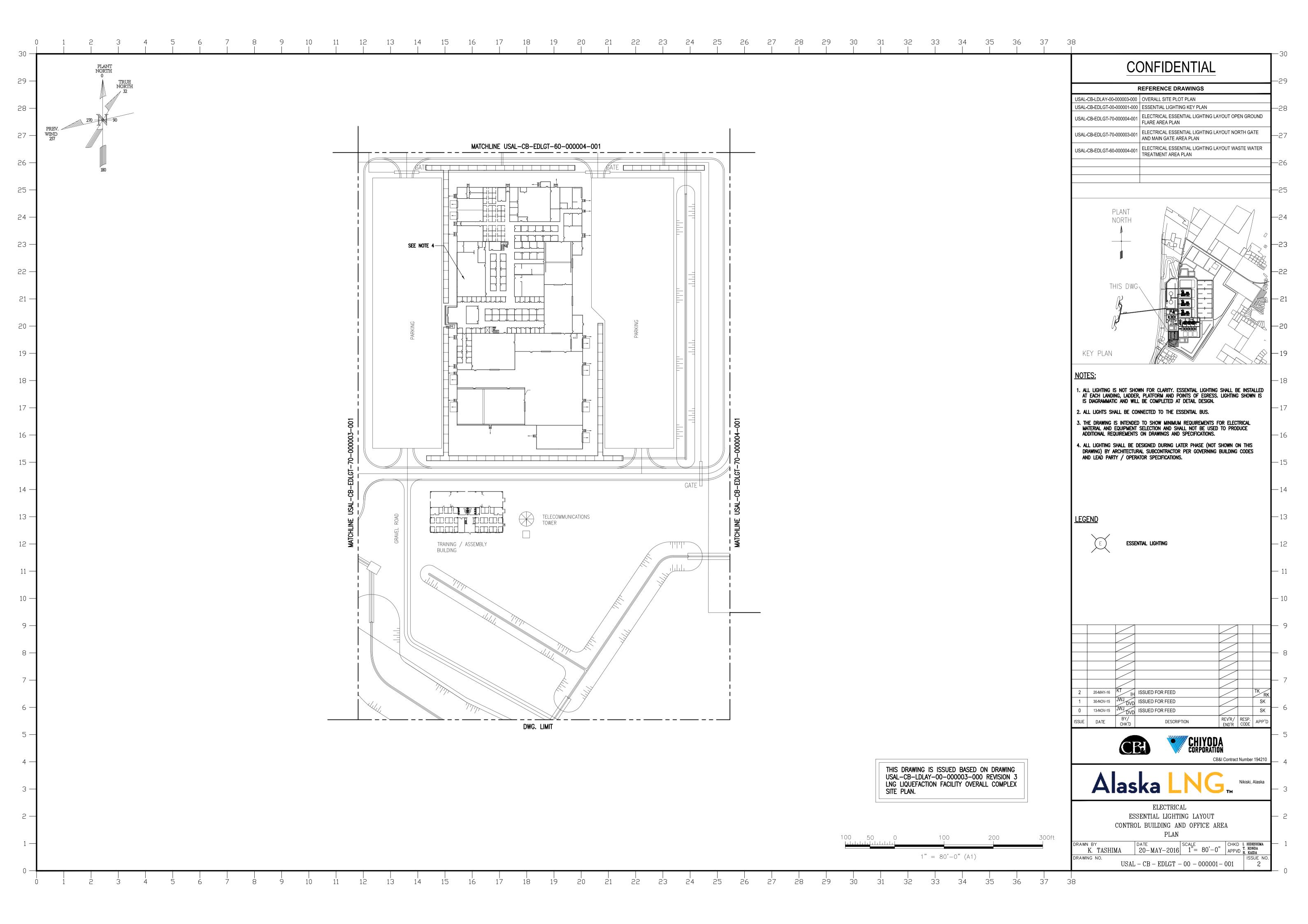


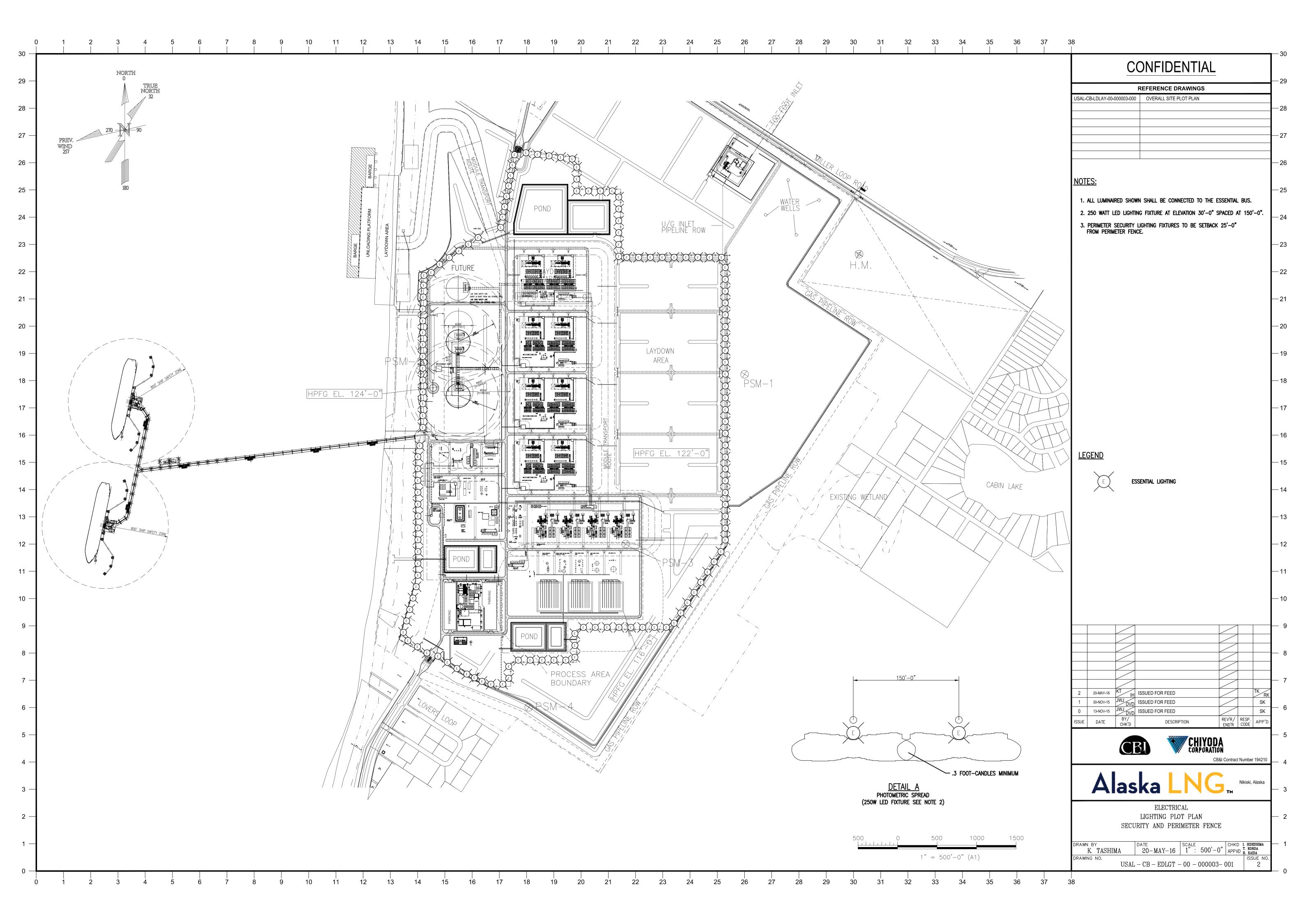
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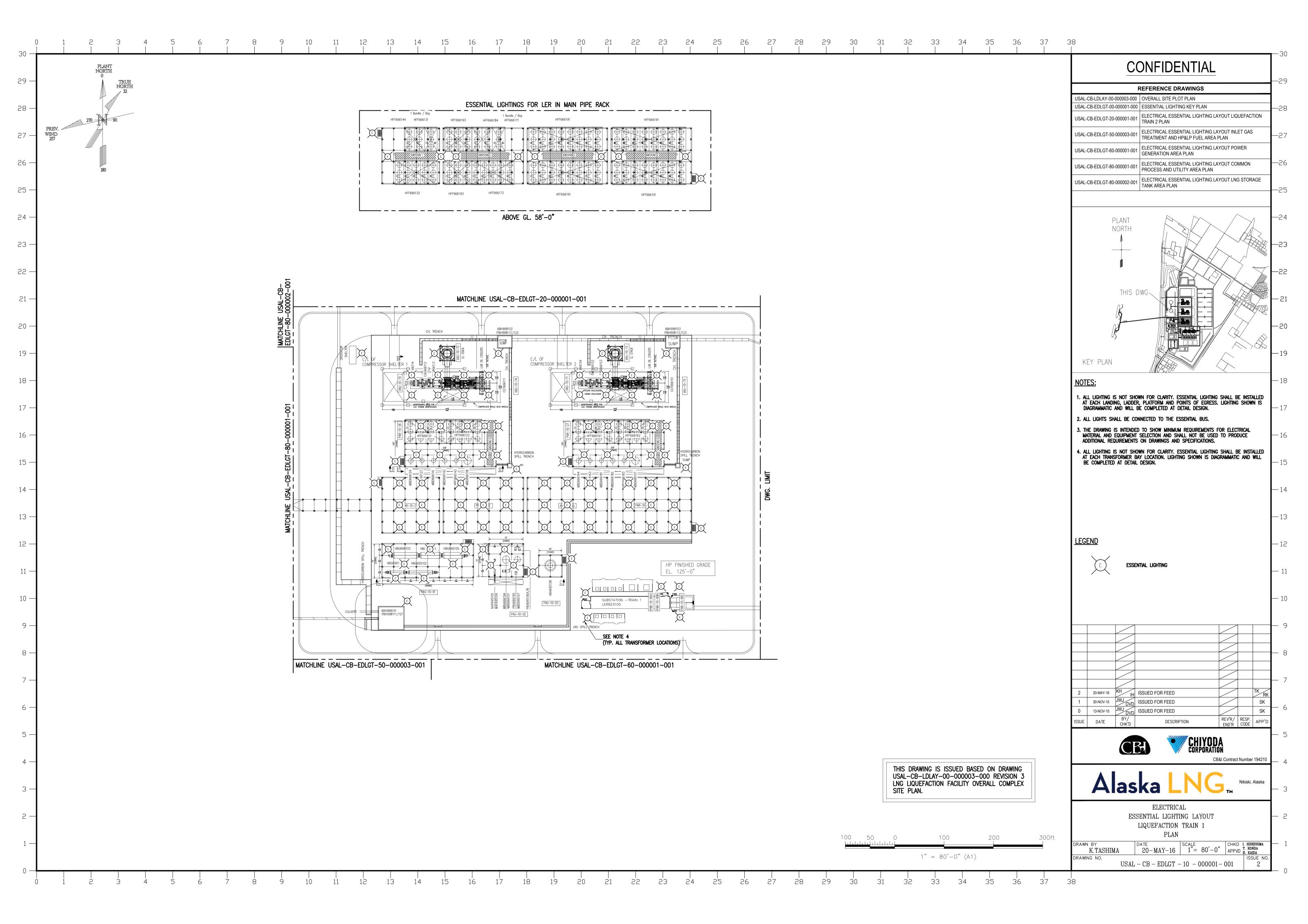
E.11 - Essential Lighting Drawings

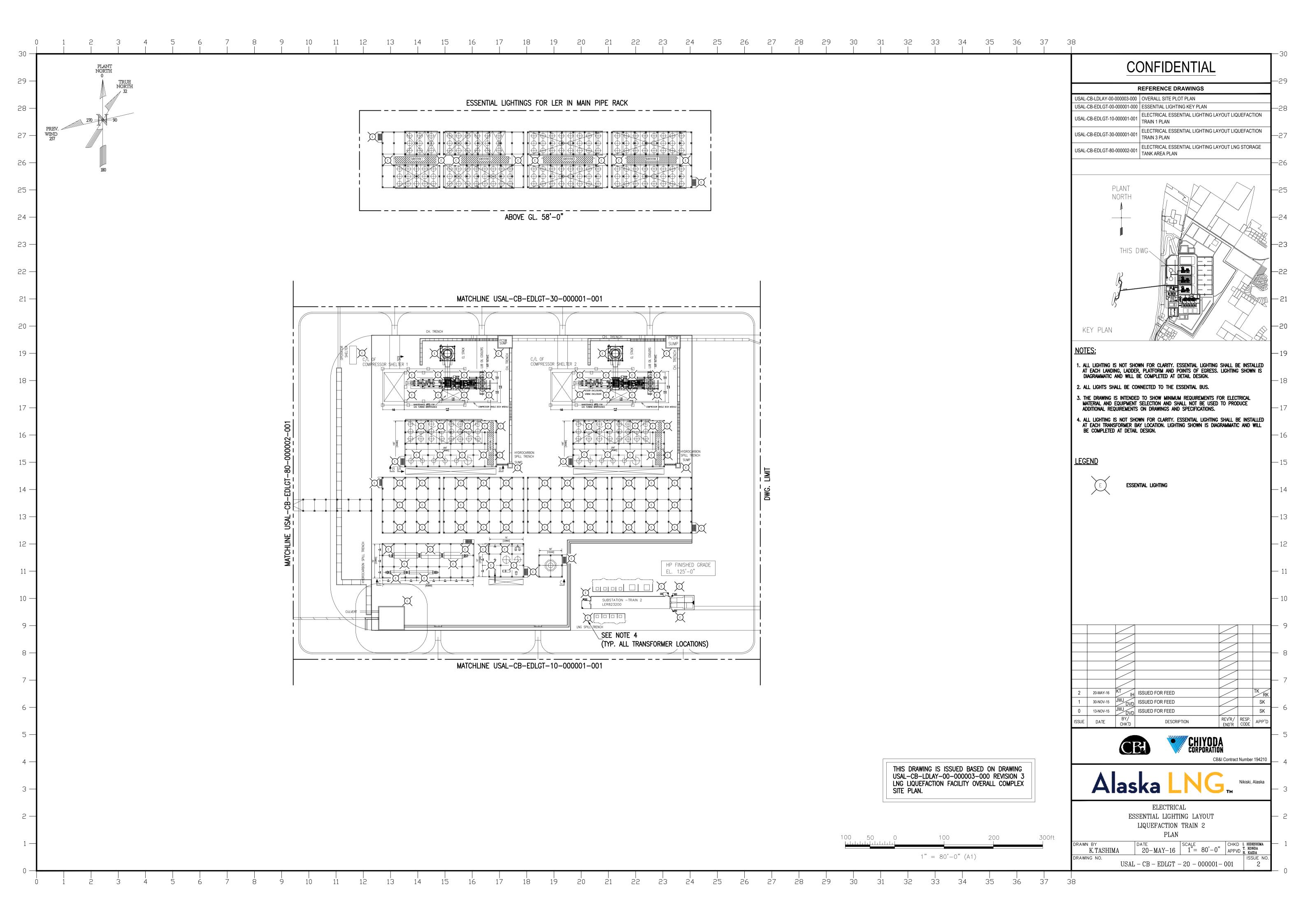
Document Number:	Description:	Revision:	Appendix:
USAL-CB-EDLGT-00-000001-000	Electrical Essential Lighting Layout Key Plan	Rev 2	Public
USAL-CB-EDLGT-00-000001-001	Electrical Essential Lighting Layout Control Building and Office Area Plan	Rev 2	Public
USAL-CB-EDLGT-00-000003-001	Electrical Lighting Plot Plan Security and Perimeter Fence	Rev 2	Public
USAL-CB-EDLGT-10-000001-001	Electrical Essential Lighting Layout Liquefaction Train 1 Plan	Rev 2	Public
USAL-CB-EDLGT-20-000001-001	Electrical Essential Lighting Layout Liquefaction Train 2 Plan	Rev 2	Public
USAL-CB-EDLGT-30-000001-001	Electrical Essential Lighting Layout Liquefaction Train 3 Plan	Rev 2	Public
USAL-CB-EDLGT-50-000003-001	Electrical Essential Lighting Layout Inlet Gas Treatment and HP & LP Fuel Area Plan	Rev 2	Public
USAL-CB-EDLGT-60-000001-001	Electrical Essential Lighting Layout Power Generation Area Plan	Rev 2	Public
USAL-CB-EDLGT-60-000002-001	Electrical Essential Lighting Layout Non- Hydrocarbon Utility Area Plan	Rev 2	Public
USAL-CB-EDLGT-60-000004-001	Electrical Essential Lighting Layout Waste Water Treatment Area Plan	Rev 2	Public
USAL-CB-EDLGT-70-000002-001	Electrical Essential Lighting Layout Condensate Loading Area Plan	Rev 2	Public
USAL-CB-EDLGT-70-000003-001	Electrical Essential Lighting Layout North Gate and Main Gate Area Plan	Rev 2	Public
USAL-CB-EDLGT-70-000004-001	Electrical Essential Lighting Layout Open Ground Flare Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000001-001	Electrical Essential Lighting Layout Common Process and Utility Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000002-001	Electrical Essential Lighting Layout LNG Storage Tank Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000003-001	Electrical Essential Lighting Layout LNG Storage Tank Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000004-001	Electrical Essential Lighting Layout Trestle Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000005-001	Electrical Essential Lighting Layout Trestle Area Plan	Rev 2	Public
USAL-CB-EDLGT-80-000006-001	Electrical Essential Lighting Layout Berth 1 Area Plan	Rev 2	Public

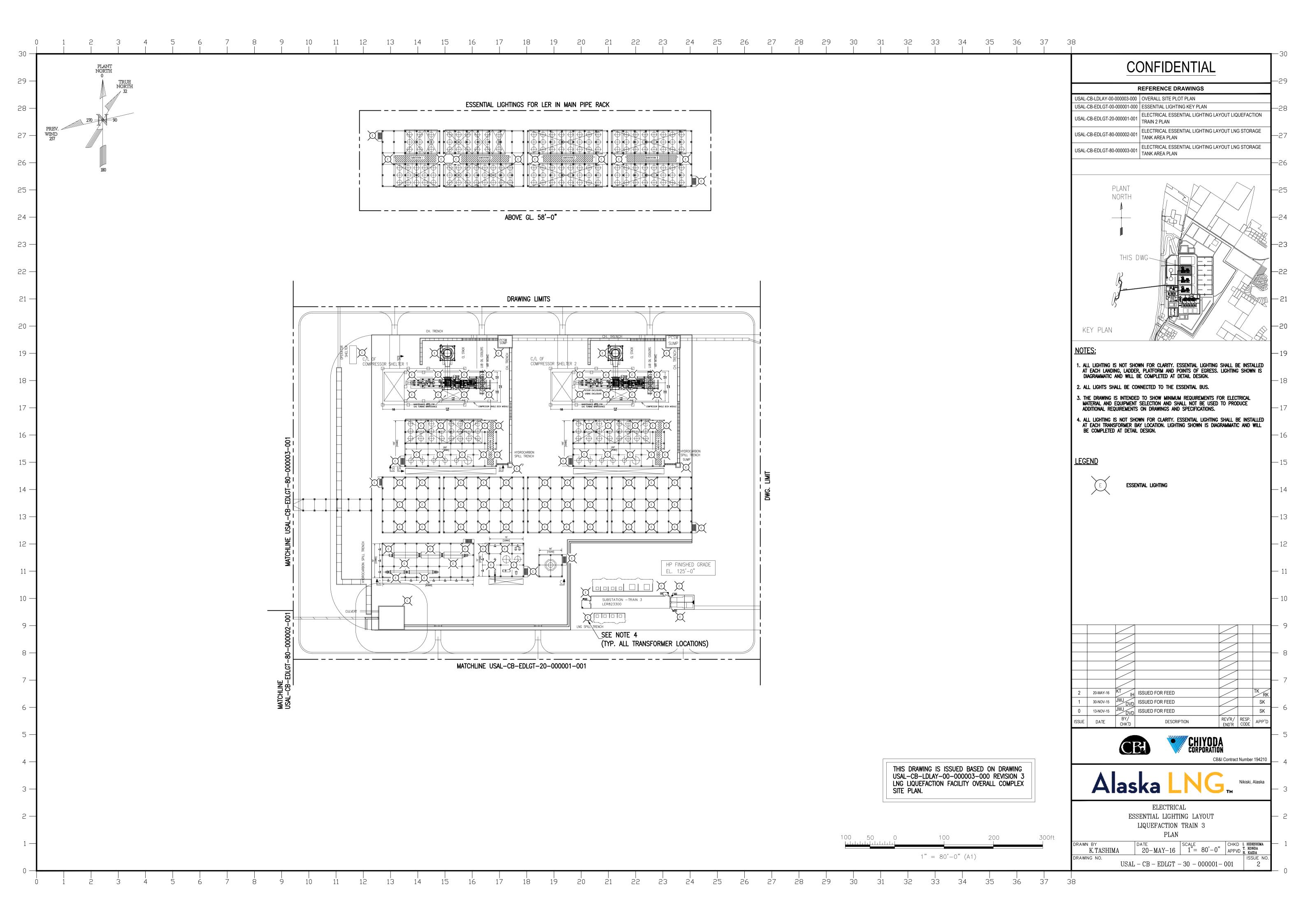


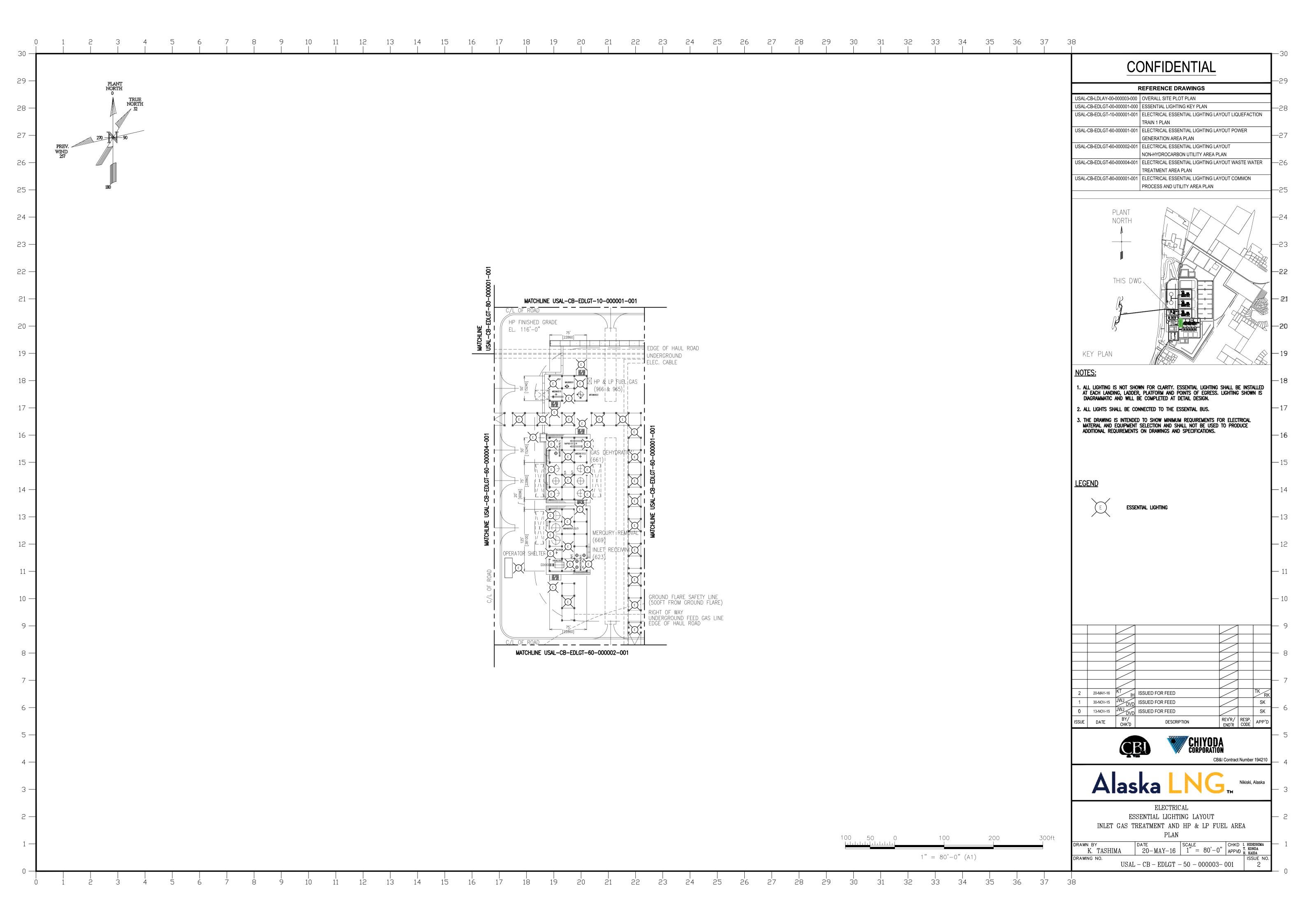


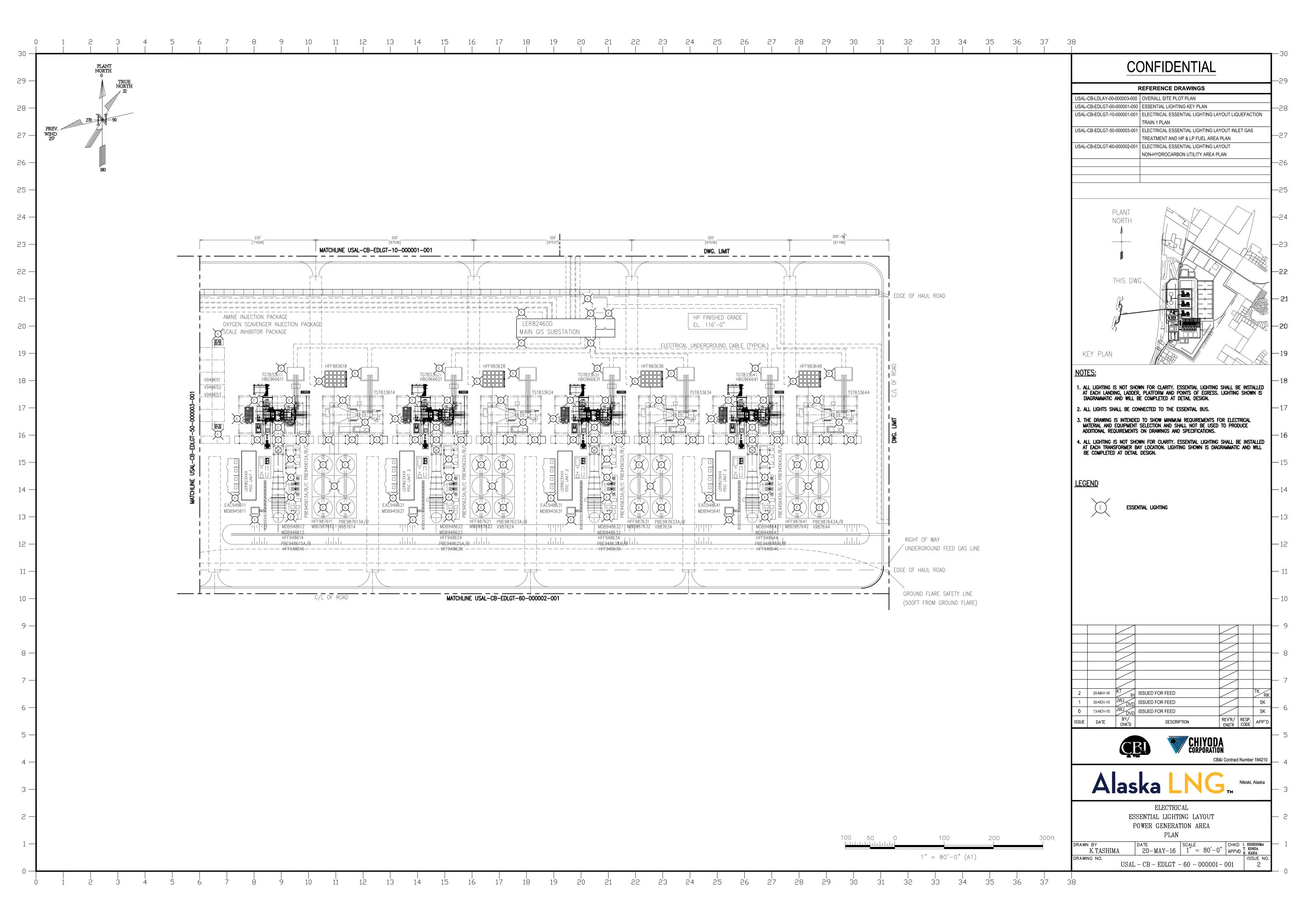


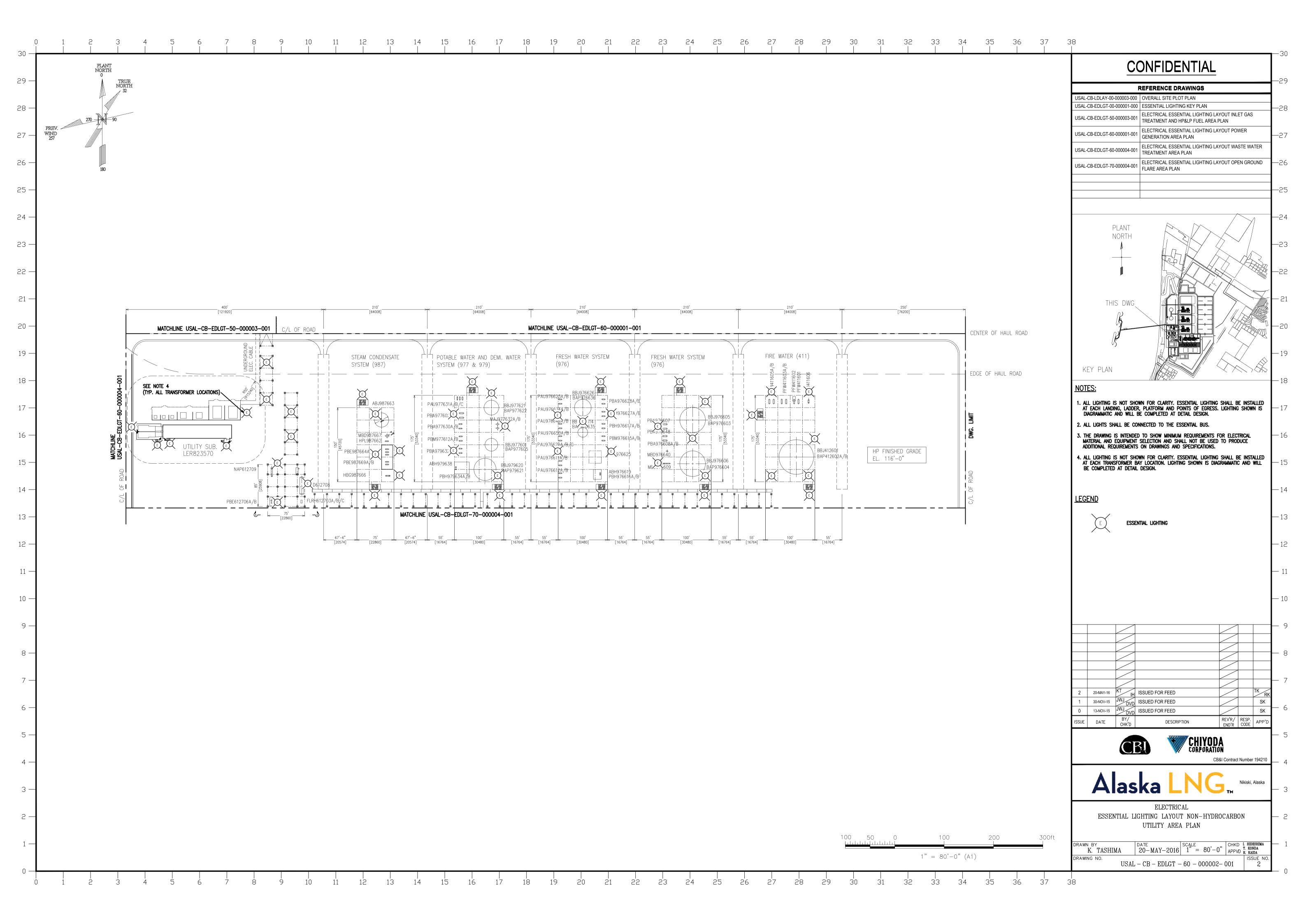


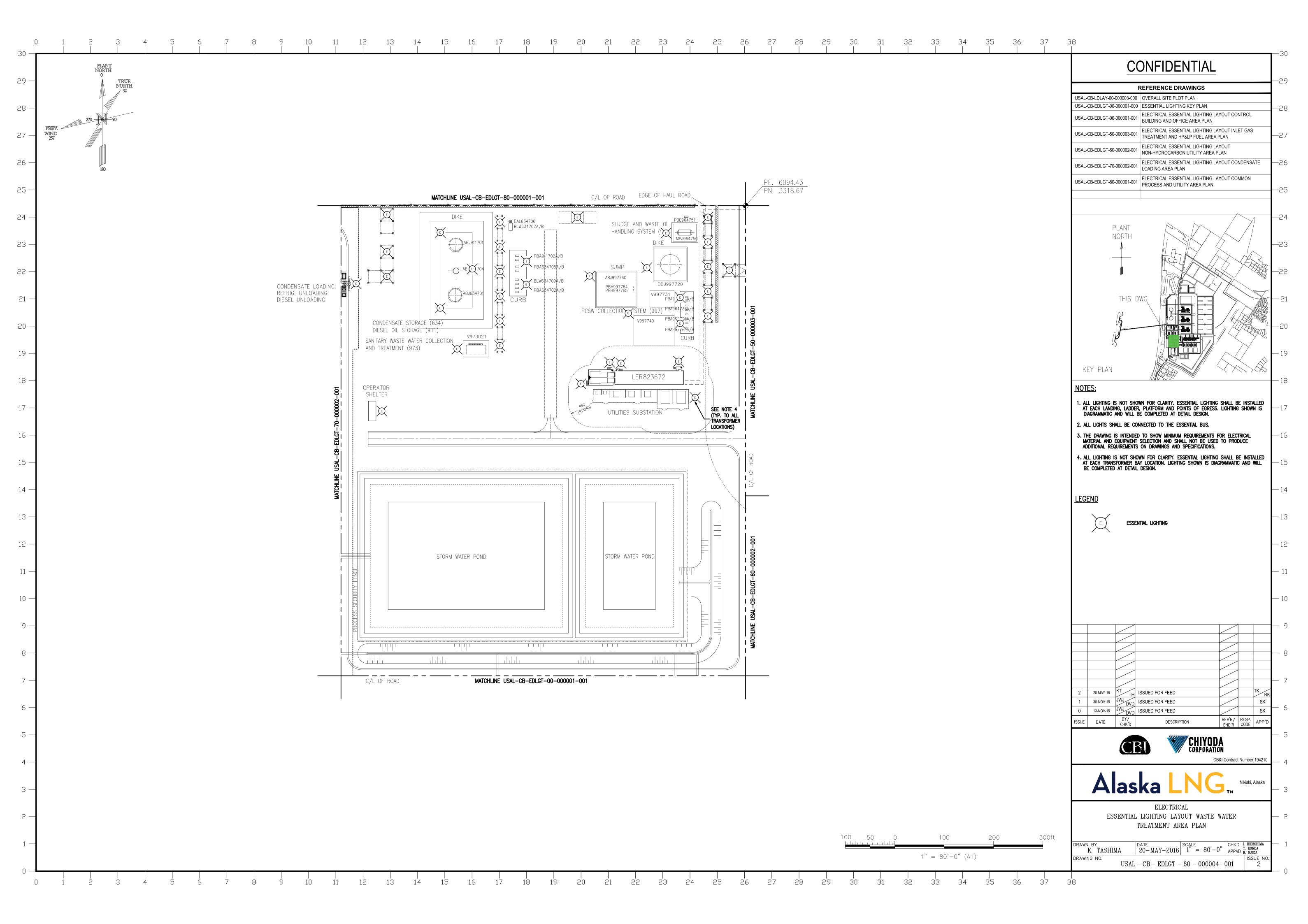


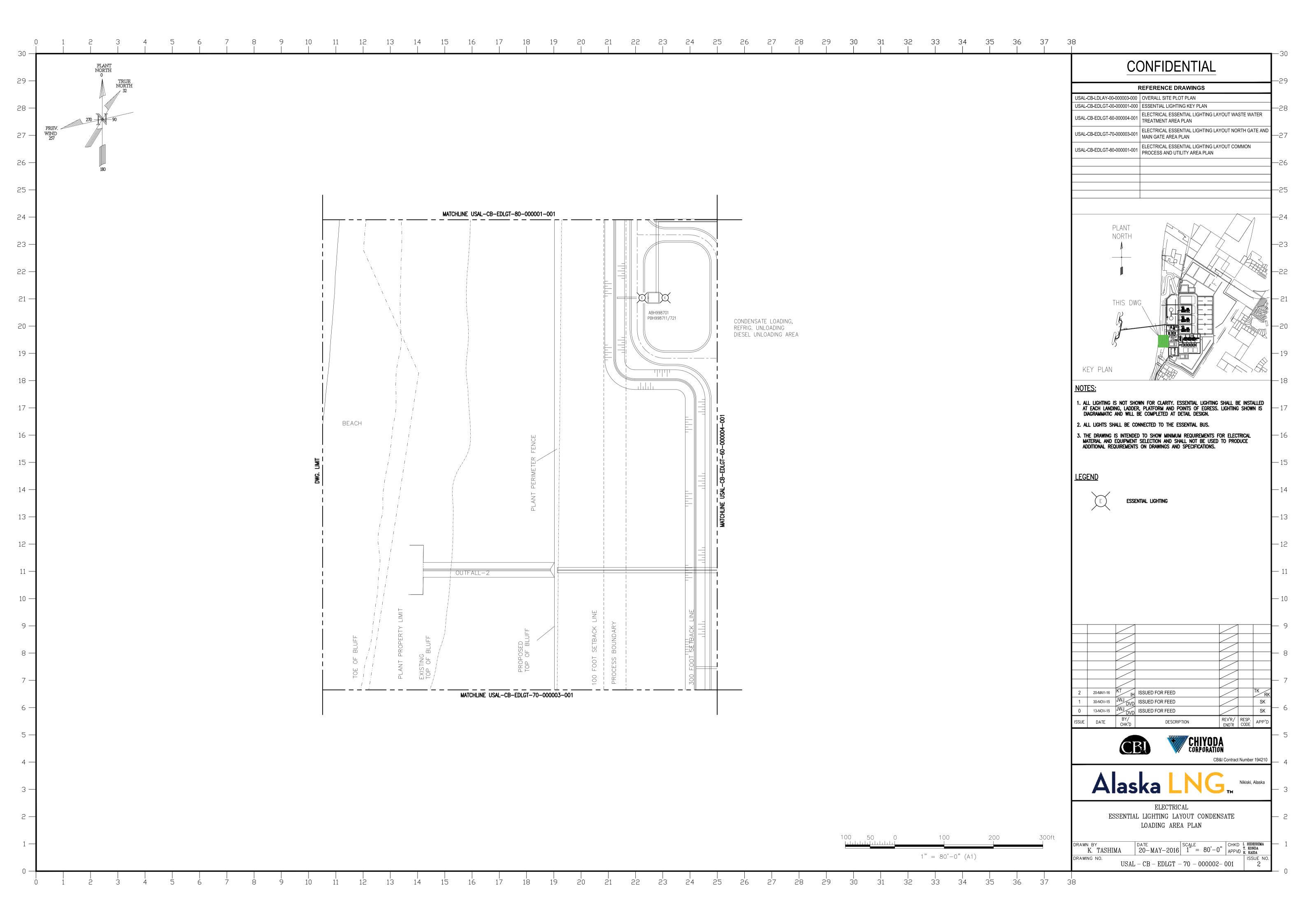


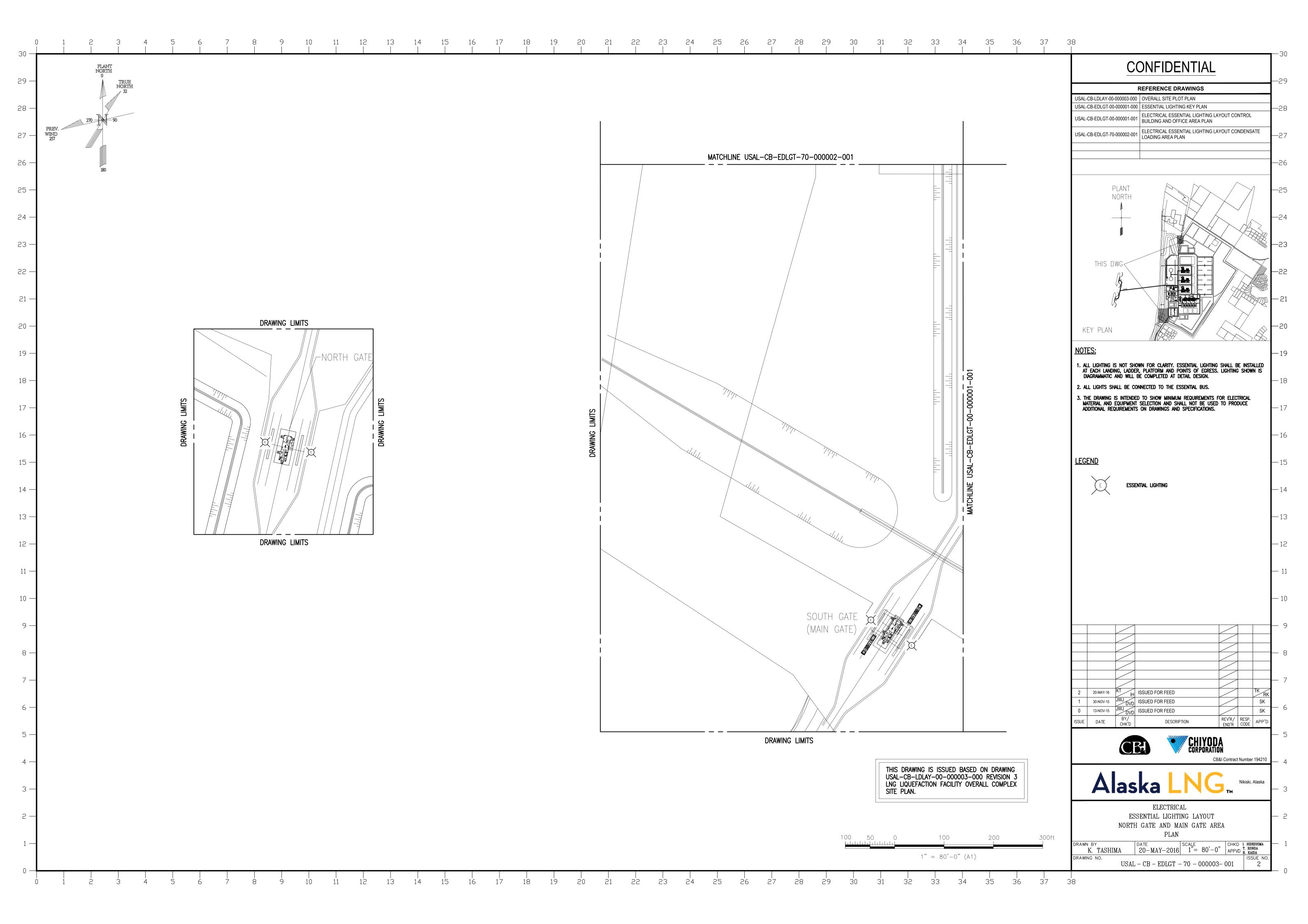


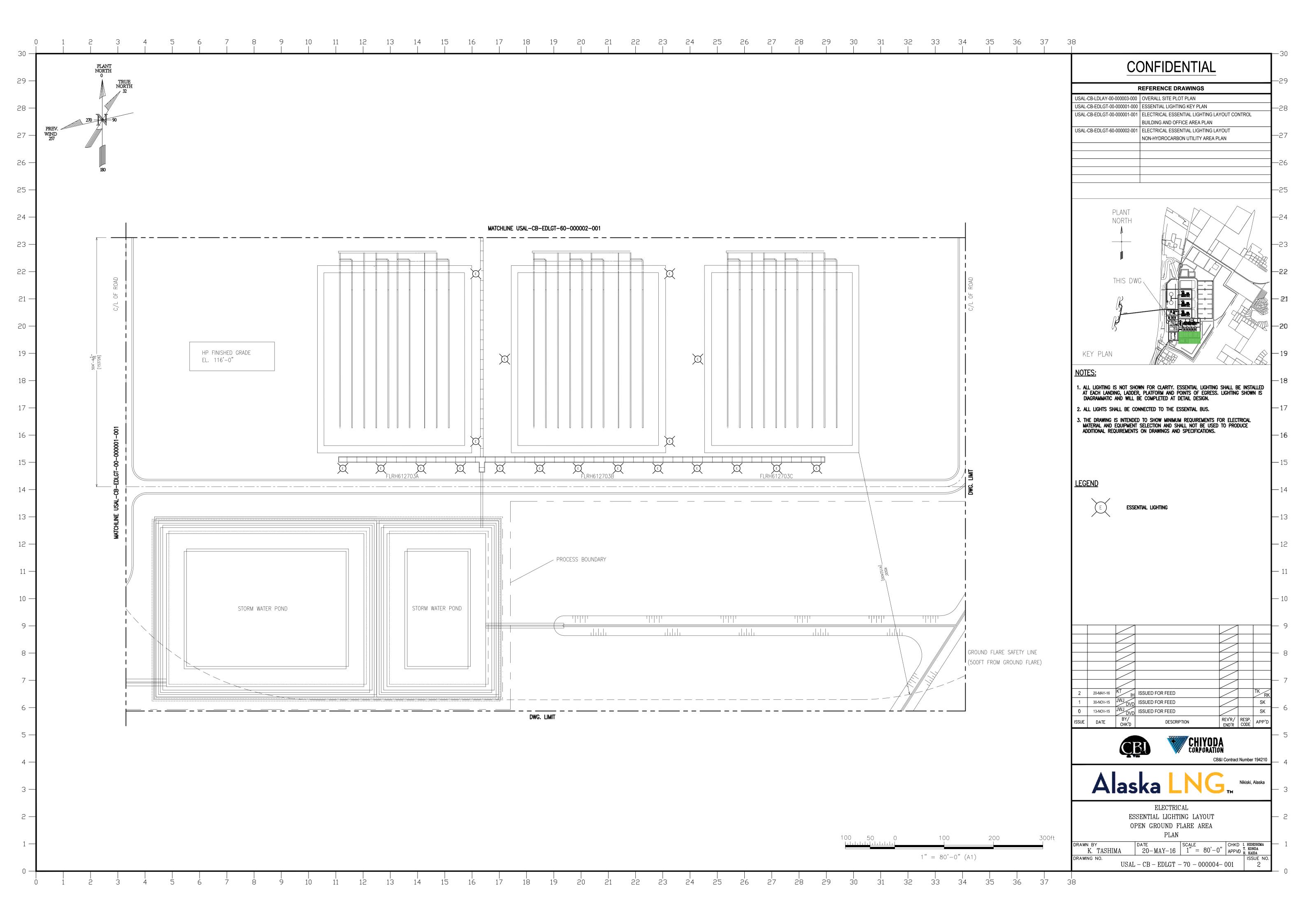


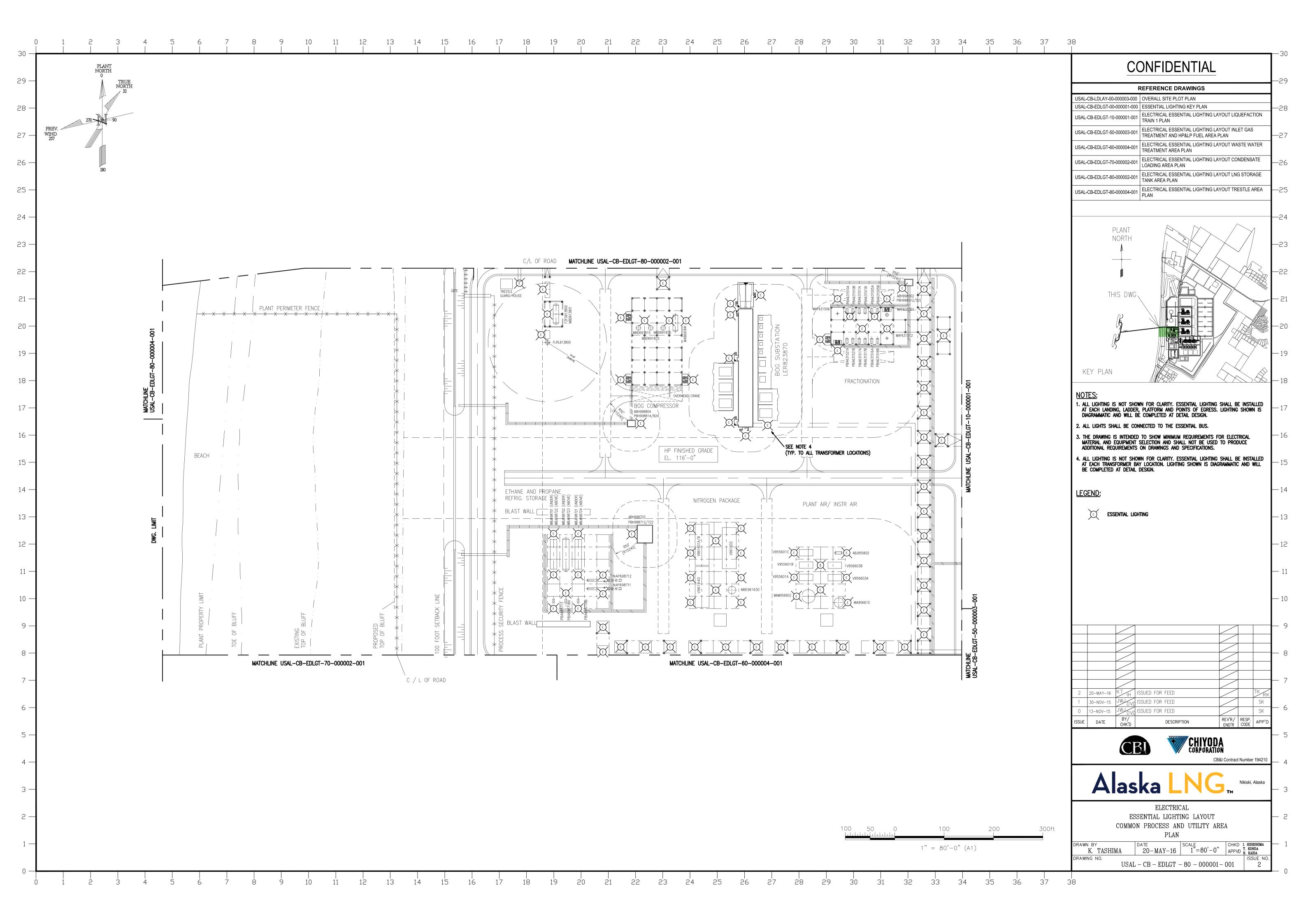


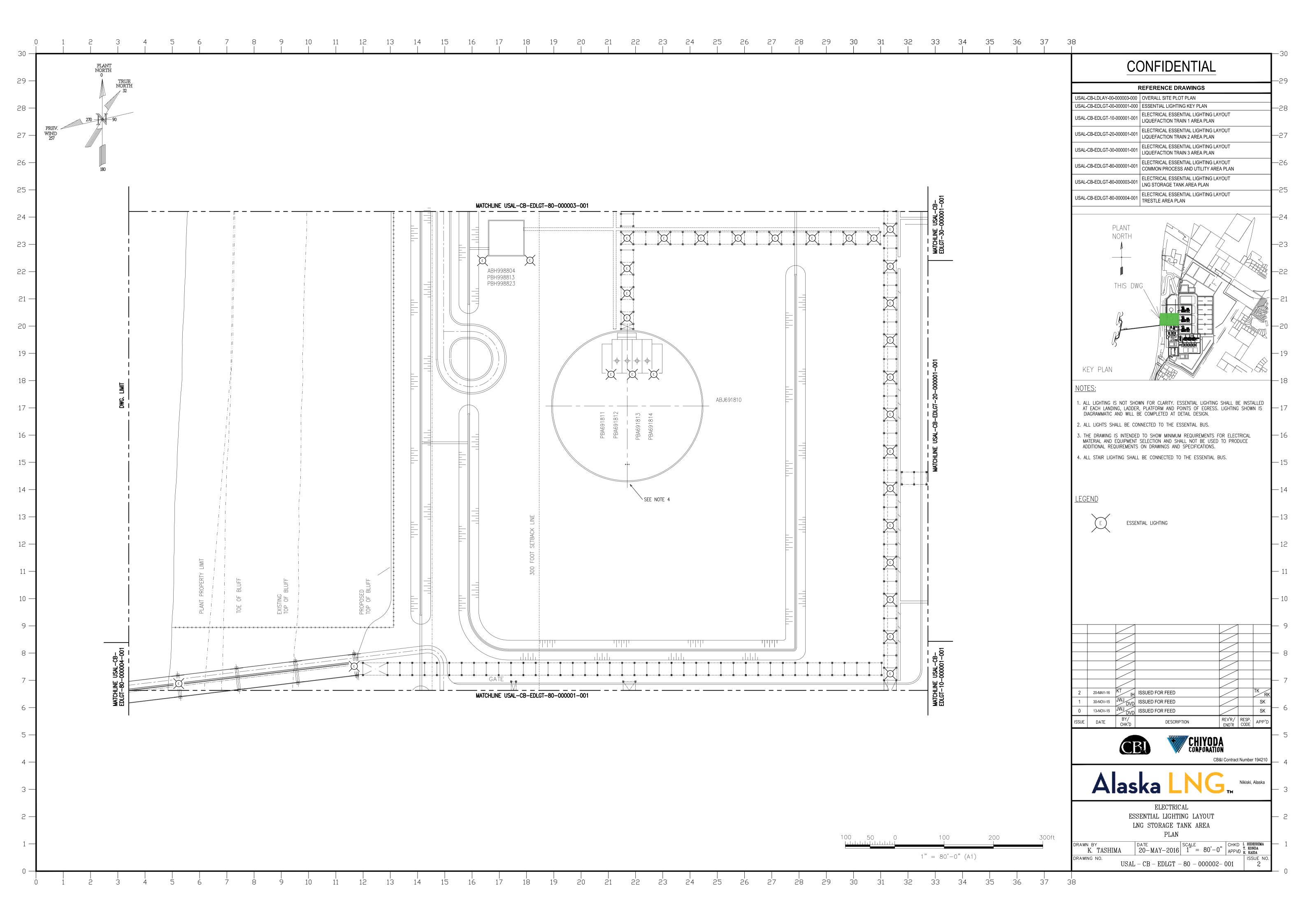


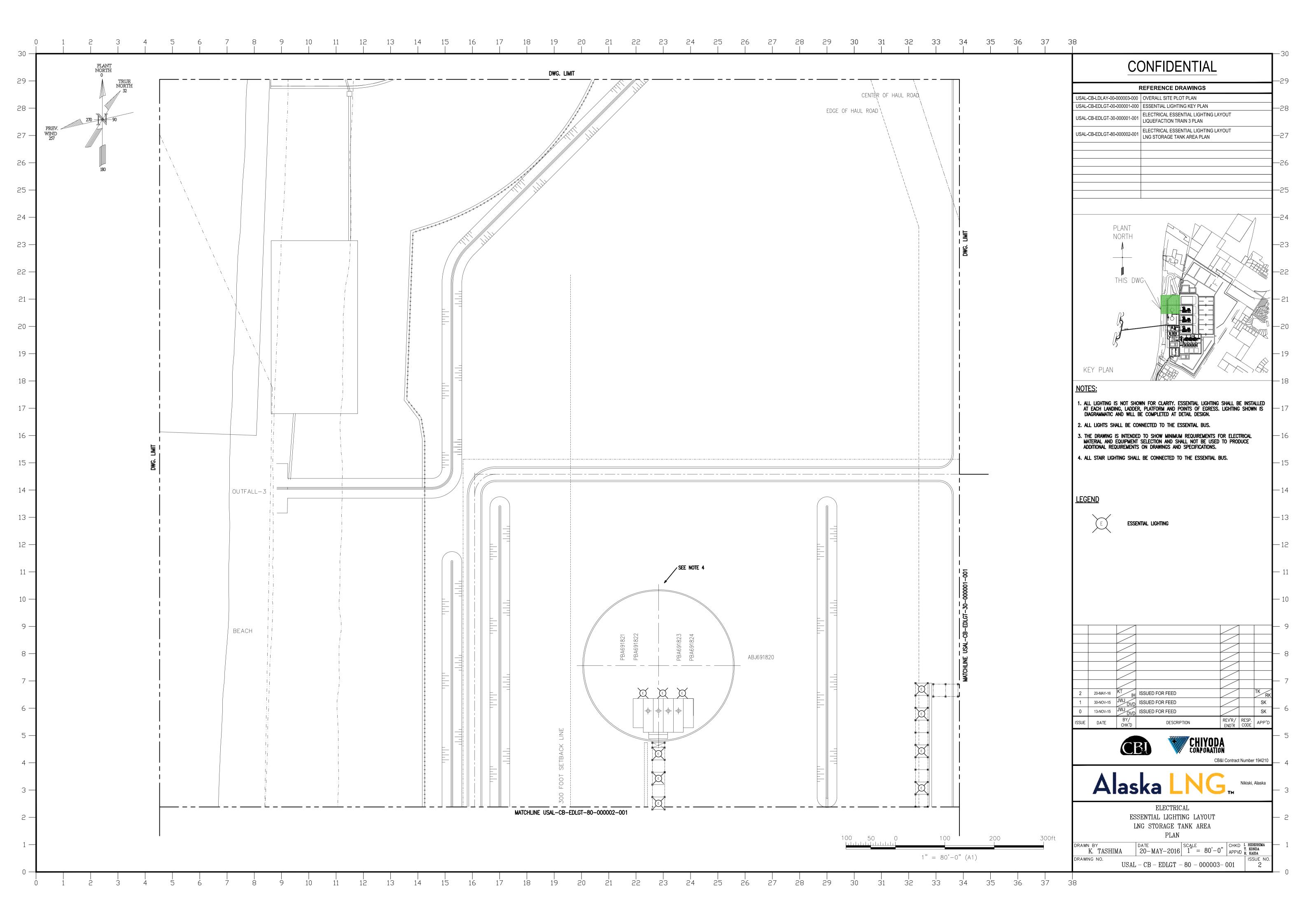


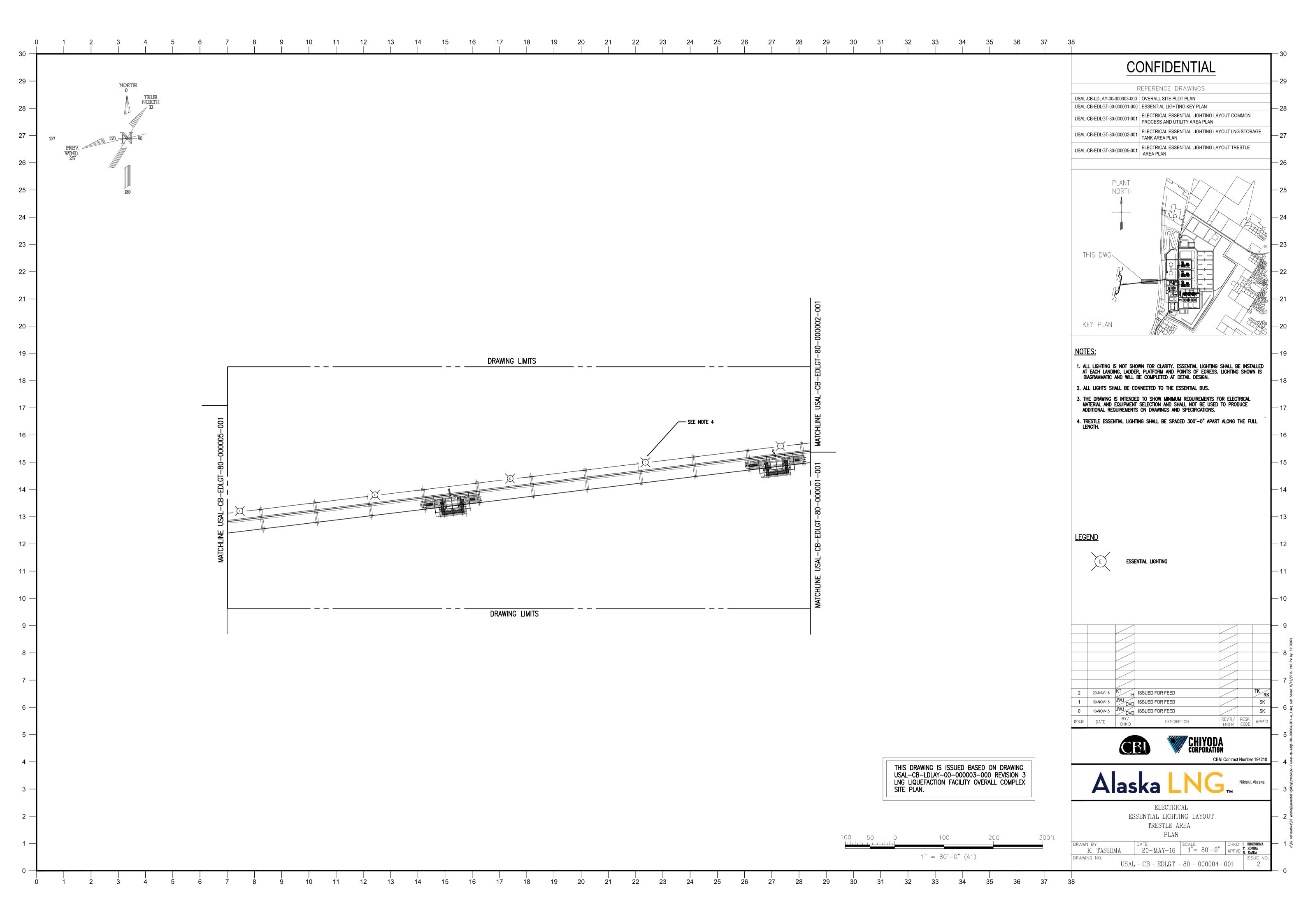


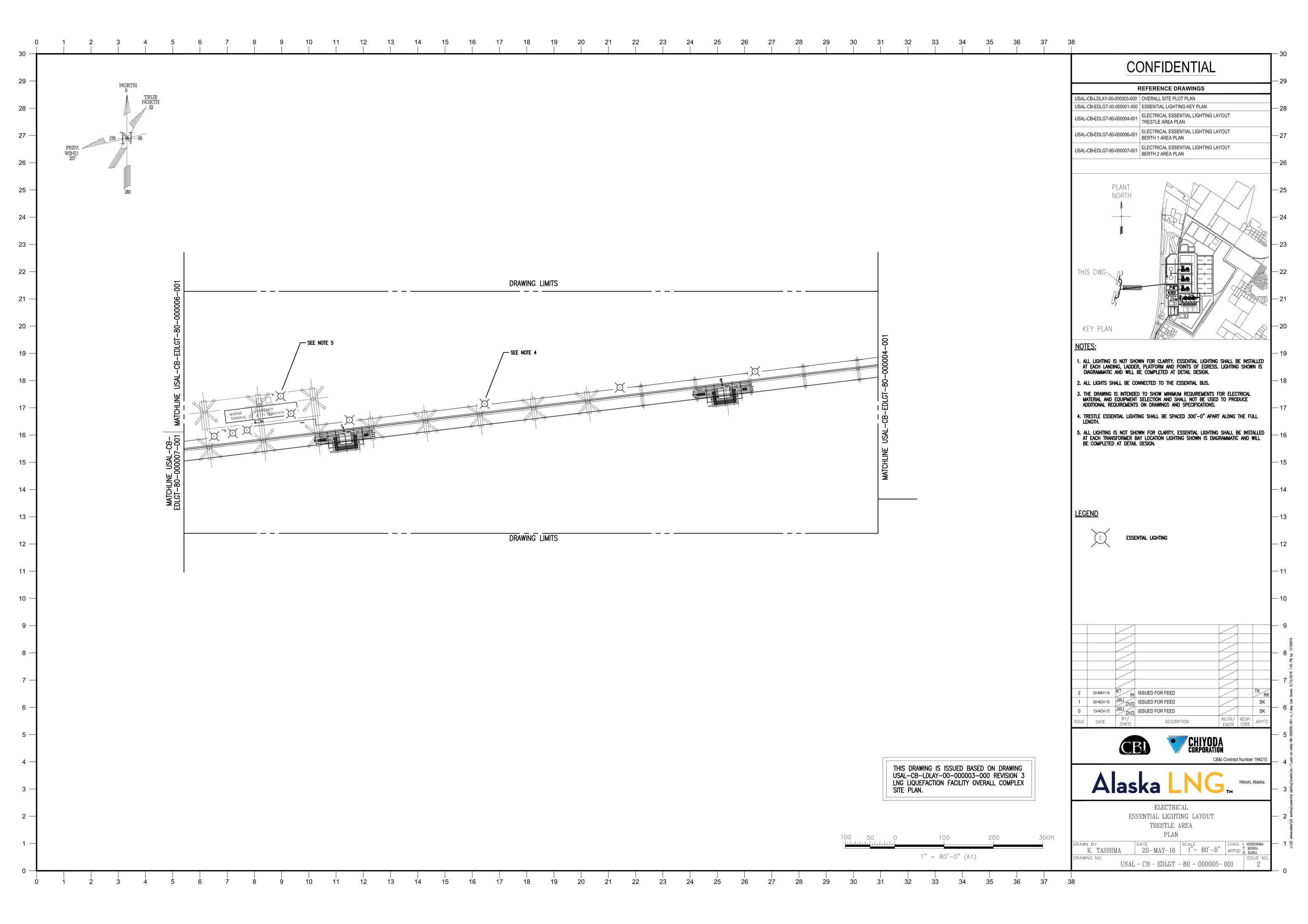


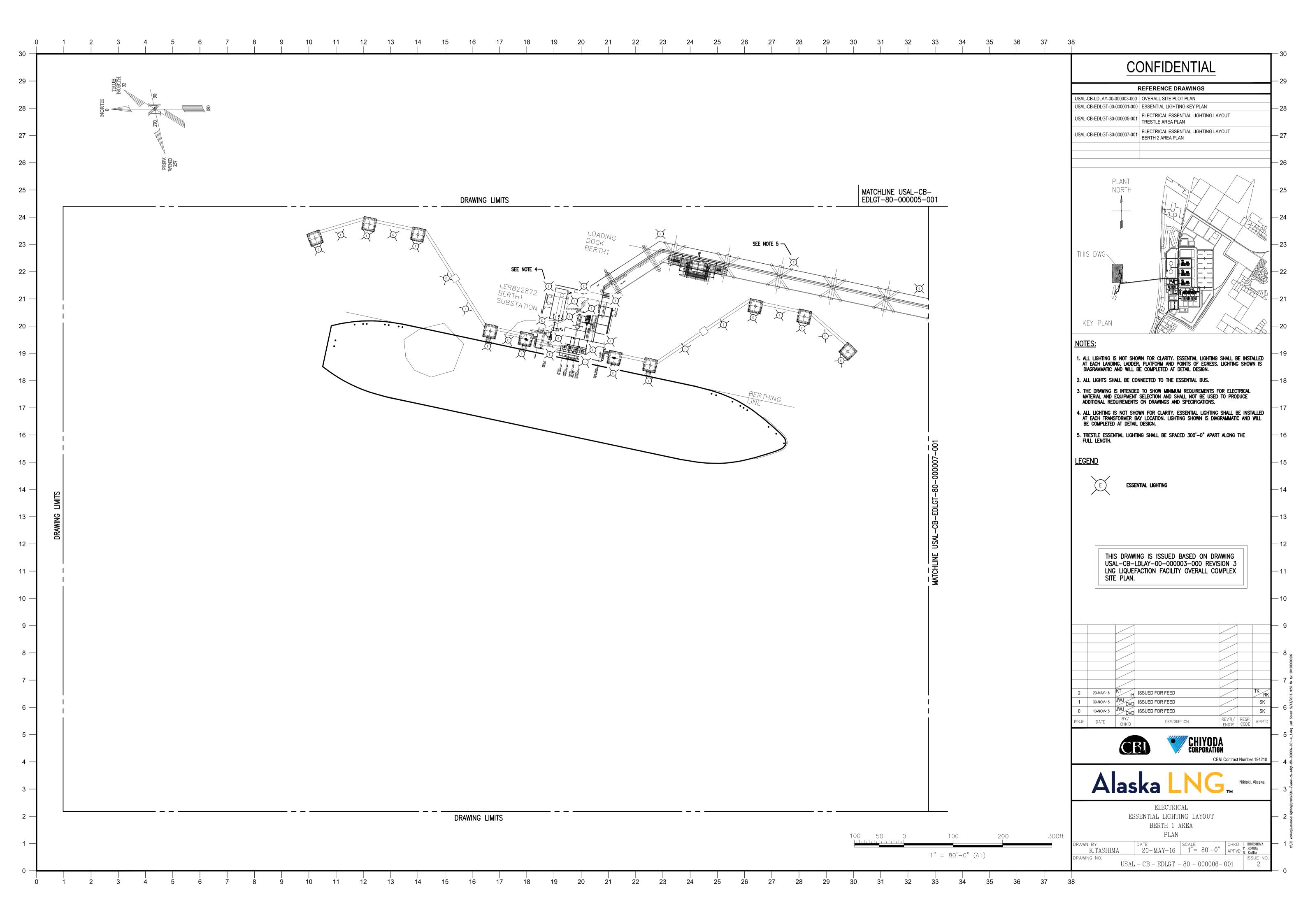


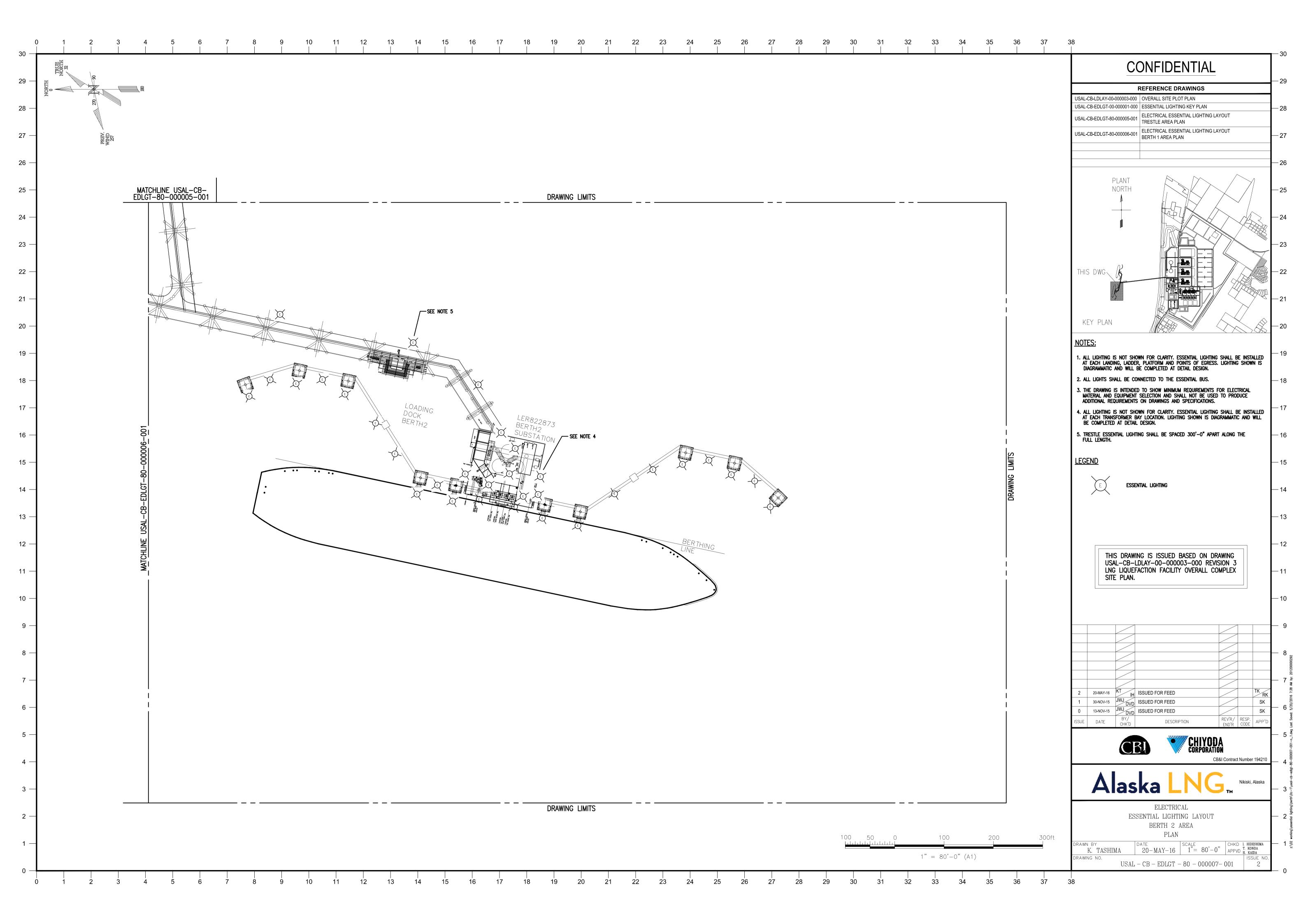


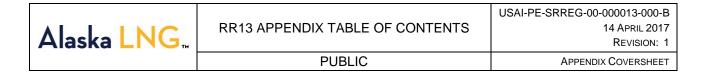












APPENDIX 13G - HAZARD IDENTIFICATION

G.2 – Simultaneous Operations Studies

Document Number:	Description:	Revision:	Appendix:
N/A	N/A	N/A	Public



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G.3 - Waterway Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



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G.4 – Road Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



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G.5 – Rail Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



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G.6 – Air Safety and Reliability Impact Studies

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



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PUBLIC	APPENDIX COVERSHEET

G.7 – Crane and Lifting Impact Studies

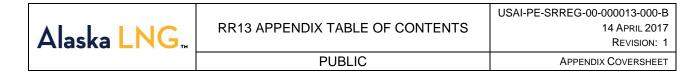
Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



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RR13 APPENDIX TABLE OF CONTENTS	14 April 2017
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PUBLIC	APPENDIX COVERSHEET

G.8 – Security Threat and Vulnerability Analyses

Document Number:	Description:	Revision:	Appendix:
N/A	Will be provided in detailed design, if requested	N/A	Public



APPENDIX 13H - HAZARD ANALYSES

H.1 – Safety Data Sheets

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-HSE-RTA-DOC-00006	Safety Data Sheets	0	Public

Alaska LNG



ALASKA LNG PROJECT – LNG SAFETY DATA SHEETS

AKLNG-4030-HSE-RTA-DOC-00006





LNG Safety Data Sheets



Rev No.	Issue Purpose:	Date:	Ву	CHK	APP
Α	Issued for Client Review	March 27, 2017	JMP	PJS	PJS
0	Issued for Information	April 4, 21017	JMP	JMW	PJS

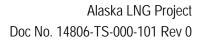




Table of Contents

Safety Data Sheets

Methane

Ethane

Propane

N-Butane

Nitrogen

Diesel

SAFETY DATA SHEET



Methane

Section 1. Identification

GHS product identifier

Chemical name : methane

Other means of

: Methane or natural gas; Marsh gas; Methyl hydride; CH4; Fire Damp;

identification
Product use

: Synthetic/Analytical chemistry.

Synonym

: Methane or natural gas; Marsh gas; Methyl hydride; CH4; Fire Damp;

SDS # : 001033

Supplier's details

: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road

Suite 100

Radnor, PA 19087-5283

1-610-687-5253

Emergency telephone number (with hours of operation)

: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard

(29 CFR 1910.1200).

Classification of the : FLAMMABLE GASES - Category 1

substance or mixture GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :





Signal word : Danger

Hazard statements : Extremely flammable gas.

May form explosive mixtures with air.

Contains gas under pressure; may explode if heated. May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use.

Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible

materials of construction. Approach suspected leak area with caution.

Prevention : Never Put cylinders into unventilated areas of passenger vehicles. Keep away from

heat, sparks, open flames and hot surfaces. - No smoking. Use and store only outdoors

or in a well ventilated place.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all

ignition sources if safe to do so.

Storage : Protect from sunlight. Protect from sunlight when ambient temperature exceeds

52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Date of issue/Date of revision : 5/20/2015. Date of previous issue : 1/27/2015. Version : 0.04 1/12

Section 2. Hazards identification

Hazards not otherwise classified

: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance
Chemical name : methane

Other means of identification

: Methane or natural gas; Marsh gas; Methyl hydride; CH4; Fire Damp;

CAS number/other identifiers

CAS number : 74-82-8 Product code : 001033

Ingredient name	%	CAS number
methane	100	74-82-8

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact: Immediately flush eyes with plenty of water, occasionally lifting the upper and lower

eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10

minutes. Get medical attention if irritation occurs.

Inhalation: Remove victim to fresh air and keep at rest in a position comfortable for breathing. If

not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar,

tie, belt or waistband.

Skin contact: Wash contaminated skin with soap and water. Remove contaminated clothing and

shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms

occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact: Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contactContact with rapidly expanding gas may cause burns or frostbite.FrostbiteTry to warm up the frozen tissues and seek medical attention.

Ingestion: As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact: No specific data.Inhalation: No specific data.Skin contact: No specific data.

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Section 4. First aid measures

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician

: Treat symptomatically. Contact poison treatment specialist immediately if large

quantities have been ingested or inhaled.

Specific treatments

: No specific treatment.

Protection of first-aiders

: No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media

: Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media

: None known.

carbon monoxide

Specific hazards arising from the chemical

: Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products

Decomposition products may include the following materials: carbon dioxide

Special protective actions for fire-fighters

: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters

Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

: Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders:

If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions

: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

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Section 6. Accidental release measures

Methods and materials for containment and cleaning up

Small spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures

: Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

: Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
methane	ACGIH TLV (United States, 3/2012).
	TWA: 1000 ppm 8 hours.

Appropriate engineering controls

: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls

: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

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Section 8. Exposure controls/personal protection

Hygiene measures

: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with sideshields.

Skin protection

Hand protection

: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection

: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear antistatic protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection

: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Compressed gas.]

Color : Colorless.

Molecular weight : 16.05 g/mole

Molecular formula : C-H4

Boiling/condensation point : -161.48°C (-258.7°F)

Melting/freezing point : -187.6°C (-305.7°F)

Critical temperature : -82.45°C (-116.4°F)

Odor : Odorless.
Odor threshold : Not available.
pH : Not available.

Flash point : Closed cup: -188.15°C (-306.7°F)

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open

flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive

(flammable) limits

Lower: 1.8% Upper: 8.4%

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Section 9. Physical and chemical properties

Vapor pressure : Not available.

Vapor density 0.55 (Air = 1) Liquid Density@BP: 26.5 lb/ft3 (424.5 kg/m3)

: 2.3641 Specific Volume (ft ³/lb)

Gas Density (lb/ft 3) : 0.423 (25°C / 77 to °F)

Relative density : Not applicable. **Solubility** : Not available. : 0.0244 g/l Solubility in water

Partition coefficient: n-

octanol/water

: 1.09

Auto-ignition temperature : 287°C (548.6°F) **Decomposition temperature** : Not available. **SADT** : Not available. : Not applicable. **Viscosity**

Section 10. Stability and reactivity

Reactivity No specific test data related to reactivity available for this product or its ingredients.

: The product is stable. Chemical stability

Possibility of hazardous

reactions

: Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld,

braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatibility with various

substances

: Extremely reactive or incompatible with the following materials: oxidizing materials.

Hazardous decomposition

products

: Under normal conditions of storage and use, hazardous decomposition products should

not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Date of issue/Date of revision Version 6/12 : 5/20/2015. Date of previous issue : 1/27/2015 : 0.04

Section 11. Toxicological information

Not available

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely

routes of exposure

: Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact: Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion: As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate : Not available.

effects

Potential delayed effects : Not available.

Long term exposure

Potential immediate : Not available.

effects

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
 Carcinogenicity : No known significant effects or critical hazards.
 Mutagenicity : No known significant effects or critical hazards.
 Teratogenicity : No known significant effects or critical hazards.
 Developmental effects : No known significant effects or critical hazards.
 Fertility effects : No known significant effects or critical hazards.

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Section 11. Toxicological information

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	LogPow	BCF	Potential
methane	1.09	-	low

Mobility in soil

Soil/water partition coefficient (Koc)

: Not available.

Other adverse effects

: No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods

: The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1971	UN1971	UN1971	UN1971	UN1971
UN proper shipping name	Methane, compressed	Methane, compressed or Methane or Natural gas, compressed (with high methane content)	Methane, compressed	Methane, compressed	Methane, compressed
Transport hazard class(es)	2.1	2.1	2.1	2.1	2.1

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Section 14. Transport information

Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information		Explosive Limit and Limited Quantity Index 0.125 ERAP Index 3000 Passenger Carrying Ship Index Forbidden Passenger Carrying Road or Rail Index Forbidden	-	-	Passenger and Cargo Aircraft Quantity Iimitation: 0 Forbidden Cargo Aircraft Only Quantity limitation: 150 kg

[&]quot;Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : Transport within user's premises: always transport in closed containers that are

upright and secure. Ensure that persons transporting the product know what to do in the

event of an accident or spillage.

Transport in bulk according: Not available.

to Annex II of MARPOL 73/78 and the IBC Code

Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: Not determined

> United States inventory (TSCA 8b): This material is listed or exempted. Clean Air Act (CAA) 112 regulated flammable substances: methane

Clean Air Act Section 112

(b) Hazardous Air **Pollutants (HAPs)** : Not listed

Clean Air Act Section 602

Class I Substances

: Not listed

Clean Air Act Section 602

Class II Substances

: Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals)

: Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard

Sudden release of pressure

Composition/information on ingredients

Date of issue/Date of revision : 5/20/2015. Date of previous issue : 1/27/2015 Version : 0.04 9/12

Section 15. Regulatory information

Name	%	hazard	Sudden release of pressure		(acute) health	Delayed (chronic) health hazard
methane	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts: This material is listed.New York: This material is not listed.New Jersey: This material is listed.Pennsylvania: This material is listed.

Canada inventory: This material is listed or exempted.

International regulations

International lists : Australia inventory (AICS): This material is listed or exempted.

China inventory (IECSC): This material is listed or exempted.

Japan inventory: This material is listed or exempted. Korea inventory: This material is listed or exempted. Malaysia Inventory (EHS Register): Not determined.

New Zealand Inventory of Chemicals (NZIoC): This material is listed or exempted.

Philippines inventory (PICCS): This material is listed or exempted.

Taiwan inventory (CSNN): Not determined.

Chemical Weapons

Convention List Schedule

I Chemicals

Chemical Weapons

Convention List Schedule

II Chemicals

Chemical Weapons

Convention List Schedule

III Chemicals

: Not listed

: Not listed

: Not listed

Canada

WHMIS (Canada)
: Class A: Compressed gas.

Class B-1: Flammable gas.

CEPA Toxic substances: This material is listed. **Canadian ARET**: This material is not listed. **Canadian NPRI**: This material is listed.

Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Date of issue/Date of revision : 5/20/2015. Date of previous issue : 1/27/2015. Version : 0.04 10/12

Section 16. Other information

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

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Date of previous issue : 1/27/2015.

Version : 0.04

Key to abbreviations : ATE = Acute Toxicity Estimate

BCF = Bioconcentration Factor

GHS = Globally Harmonized System of Classification and Labelling of Chemicals

IATA = International Air Transport Association

IBC = Intermediate Bulk Container

IMDG = International Maritime Dangerous Goods

LogPow = logarithm of the octanol/water partition coefficient

MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships,

1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)

UN = United NationsACGIH – American Conference of Governmental Industrial

Hygienists

AIHA - American Industrial Hygiene Association

CAS - Chemical Abstract Services

CEPA - Canadian Environmental Protection Act

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

(EPA)

CFR – United States Code of Federal Regulations

CPR – Controlled Products Regulations DSL – Domestic Substances List GWP – Global Warming Potential

IARC – International Agency for Research on Cancer ICAO – International Civil Aviation Organisation

Inh - Inhalation

LC - Lethal concentration

LD - Lethal dosage

NDSL - Non-Domestic Substances List

NIOSH - National Institute for Occupational Safety and Health

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Section 16. Other information

TDG – Canadian Transportation of Dangerous Goods Act and Regulations

TLV - Threshold Limit Value

TSCA - Toxic Substances Control Act

WEEL – Workplace Environmental Exposure Level

WHMIS - Canadian Workplace Hazardous Material Information System

References : Not available.

▼ Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Date of issue/Date of revision : 5/20/2015. Date of previous issue : 1/27/2015. Version : 0.04 12/12

SAFETY DATA SHEET



Ethane

Section 1. Identification

GHS product identifier

Chemical name : ethane

Other means of identification

Bimethyl; Dimethyl; Ethyl hydride; Methylmethane; C2H6; UN 1035;

Product use

Synonym

: Bimethyl; Dimethyl; Ethyl hydride; Methylmethane; C2H6; UN 1035;

SDS#

: 001024

Supplier's details

: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road

: Synthetic/Analytical chemistry.

Suite 100

Radnor, PA 19087-5283

1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status

: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture

: FLAMMABLE GASES - Category 1

GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms





Signal word

: Danger

Hazard statements

: Extremely flammable gas.

Contains gas under pressure; may explode if heated.

May form explosive mixtures in Air.

May displace oxygen and cause rapid suffocation.

Precautionary statements

General

Response

Storage

: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flame

: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

SMOKIN

: Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all

ignition sources if safe to do so.

: Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise

classified

: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Date of issue/Date of revision : 6/1/2016 Date of previous issue : No previous validation Version : 0.01 1/11

Section 3. Composition/information on ingredients

Substance/mixture : Substance
Chemical name : ethane

Other means of identification

: Bimethyl; Dimethyl; Ethyl hydride; Methylmethane; C2H6; UN 1035;

CAS number/other identifiers

CAS number : 74-84-0 Product code : 001024

Ingredient name	%	CAS number
ethane	100	74-84-0

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower

eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If

not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical

attention immediately. Maintain an open airway. Loosen tight clothing such as a collar,

tie. belt or waistband.

Skin contact: Wash contaminated skin with soap and water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated

shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms

occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion: As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact: Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion: As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large

quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

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Section 4. First aid measures

Protection of first-aiders

: No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media

: Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media

: None known.

carbon monoxide

Specific hazards arising from the chemical

: Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products

: Decomposition products may include the following materials: carbon dioxide

Special protective actions for fire-fighters

: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters

: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

: Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders

If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For nonemergency personnel".

Environmental precautions

: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

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Section 7. Handling and storage

Precautions for safe handling

Protective measures

Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene

Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

: Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
ethane	Oxygen Depletion [Asphyxiant]

Appropriate engineering controls

: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls

: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period.

Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with sideshields.

Skin protection

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Section 8. Exposure controls/personal protection

Hand protection

: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection

: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear antistatic protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection

: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

: Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Liquefied compressed gas.]

Colorless. Color Molecular weight : 30.08 g/mole Molecular formula : C2-H6

: -161.48°C (-258.7°F) **Boiling/condensation point Melting/freezing point** : -187.6°C (-305.7°F) **Critical temperature** : 32.35°C (90.2°F)

 Odorless. Odor : Not available. **Odor threshold** pH : Not available.

: Closed cup: -104°C (-155.2°F) Flash point

Burning time Not applicable. **Burning rate** : Not applicable.

Evaporation rate : 3.85 (butyl acetate = 1)

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: oxidizing

materials.

Lower and upper explosive

: Lower: 2.9% (flammable) limits Upper: 13% Vapor pressure : 543 (psig)

Vapor density 1.1 (Air = 1)Liquid Density: BP@34.1 lb/ft3 (546 kg/m3)

Specific Volume (ft ³/lb) : 12.6582

Gas Density (lb/ft 3) : 0.079 (25°C / 77 to °F)

Relative density : Not applicable. : Not available. Solubility Solubility in water : 0.0244 g/l Partition coefficient: n-1.09

octanol/water

Auto-ignition temperature : 287°C (548.6°F) **Decomposition temperature** Not available. **SADT** : Not available.

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Section 9. Physical and chemical properties

: Not applicable.

Section 10. Stability and reactivity

Reactivity

: No specific test data related to reactivity available for this product or its ingredients.

Chemical stability

: The product is stable.

Possibility of hazardous

reactions

: Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid

: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials

: Oxidizers

Hazardous decomposition products

: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization

: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure

: Not available.

Potential acute health effects

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Section 11. Toxicological information

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion: As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate

: Not available.

effects

Potential delayed effects : Not available.

Long term exposure

Potential immediate : Not available.

effects

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
 Carcinogenicity : No known significant effects or critical hazards.
 Mutagenicity : No known significant effects or critical hazards.
 Teratogenicity : No known significant effects or critical hazards.
 Developmental effects : No known significant effects or critical hazards.
 Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	LogPow	BCF	Potential
ethane	1.09	-	low

Mobility in soil

Section 12. Ecological information

Soil/water partition coefficient (Koc)

: Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods

: The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1035	UN1035	UN1035	UN1035	UN1035
UN proper shipping name	ETHANE	ETHANE	ETHANE	ETHANE	ETHANE
Transport hazard class(es)	2.1	2.1	2.1	2.1	2.1
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	Limited quantity Yes. Packaging instruction Passenger aircraft Quantity limitation: Forbidden. Cargo aircraft Quantity limitation: 150 kg	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). Explosive Limit and Limited Quantity Index 0.125 ERAP Index 3000 Passenger Carrying Ship Index Forbidden Passenger Carrying Road or Rail Index Forbidden	-	-	Passenger and Cargo AircraftQuantity Ilmitation: 0 Forbidden Cargo Aircraft Only Quantity limitation: 150 kg

[&]quot;Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : Transport within user's premises: always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

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Section 14. Transport information

Transport in bulk according : Not available.

to Annex II of MARPOL 73/78 and the IBC Code

Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: Not determined

> United States inventory (TSCA 8b): This material is listed or exempted. Clean Air Act (CAA) 112 regulated flammable substances: ethane

Clean Air Act Section 112

(b) Hazardous Air **Pollutants (HAPs)** : Not listed

Clean Air Act Section 602

Class I Substances

: Not listed

Clean Air Act Section 602

: Not listed

Class II Substances

DEA List I Chemicals

: Not listed

(Precursor Chemicals)

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard

Sudden release of pressure

Composition/information on ingredients

Name		hazard	Sudden release of pressure	Reactive	(acute) health	Delayed (chronic) health hazard
ethane	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed. : This material is not listed. **New York New Jersey** This material is listed. : This material is listed. **Pennsylvania**

International regulations

International lists National inventory

Australia : This material is listed or exempted. Canada This material is listed or exempted. China : This material is listed or exempted. **Europe** : This material is listed or exempted. **Japan** This material is listed or exempted. Malaysia : This material is listed or exempted. **New Zealand** : This material is listed or exempted. **Philippines** This material is listed or exempted. Republic of Korea : This material is listed or exempted.

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Section 15. Regulatory information

Taiwan

: This material is listed or exempted.

Canada

WHMIS (Canada) : Class A: Compressed gas.

Class B-1: Flammable gas.

CEPA Toxic substances: This material is listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.

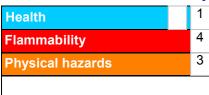
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
· ·	Regulatory data According to package

History

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Section 16. Other information

Key to abbreviations

: ATE = Acute Toxicity Estimate

BCF = Bioconcentration Factor

GHS = Globally Harmonized System of Classification and Labelling of Chemicals

IATA = International Air Transport Association

IBC = Intermediate Bulk Container

IMDG = International Maritime Dangerous Goods

LogPow = logarithm of the octanol/water partition coefficient

MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships,

1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)

UN = United Nations

References

: Not available.

✓ Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

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SAFETY DATA SHEET



Propane

Section 1. Identification

GHS product identifier

Chemical name :

Other means of identification

: Propane: propane

: Propyl hydride; n-Propane; Dimethyl methane; Bottled gas; propane in gaseous state; propane liquefied, n-Propane; Dimethylmethane; Freon 290; Liquefied petroleum gas;

Lpg; Propyl

hydride; R 290; C3H8; UN 1075; UN 1978; A-108; Hydrocarbon propellant.

Product use

: Synthetic/Analytical chemistry.

Synonym

: Propyl hydride; n-Propane; Dimethyl methane; Bottled gas; propane in gaseous state; propane liquefied, n-Propane; Dimethylmethane; Freon 290; Liquefied petroleum gas;

Lpg; Propyl

hydride; R 290; C3H8; UN 1075; UN 1978; A-108; Hydrocarbon propellant.

SDS#

: 001045

Supplier's details

: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road

Suite 100

Radnor, PA 19087-5283

1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status

: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture

: FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms





Signal word

: Danger

Hazard statements

: Extremely flammable gas.

Contains gas under pressure; may explode if heated.

May cause frostbite.

May form explosive mixtures in Air.

May displace oxygen and cause rapid suffocation.

Precautionary statements

General

: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention

: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response

: Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage

: Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

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Section 2. Hazards identification

Disposal

: Not applicable.

Hazards not otherwise classified

: In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance
Chemical name : propane

Other means of identification

: Propyl hydride; n-Propane; Dimethyl methane; Bottled gas; propane in gaseous state; propane liquefied, n-Propane; Dimethylmethane; Freon 290; Liquefied petroleum gas;

Lpg; Propyl

hydride; R 290; C3H8; UN 1075; UN 1978; A-108; Hydrocarbon propellant.

CAS number/other identifiers

CAS number : 74-98-6 **Product code** : 001045

Ingredient name	%	CAS number
Propane	100	74-98-6

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10

minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If

not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar,

tie, belt or waistband.

Skin contact: Wash contaminated skin with soap and water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated

clothing thoroughly with water before removing it. Get medical attention if symptoms

occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact
 Inhalation
 No known significant effects or critical hazards.
 Skin contact
 No known significant effects or critical hazards.
 No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion: As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

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Section 4. First aid measures

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician

Specific treatments

: Treat symptomatically. Contact poison treatment specialist immediately if large

quantities have been ingested or inhaled.No specific treatment.

Protection of first-aiders

: No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media

: Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media

: None known.

carbon monoxide

Specific hazards arising from the chemical

: Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products

 Decomposition products may include the following materials: carbon dioxide

Special protective actions for fire-fighters

: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters

: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

: Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders:

: If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions

: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

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Section 6. Accidental release measures

Large spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures

: Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene

: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

including any incompatibilities

Conditions for safe storage, : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Propane	NIOSH REL (United States, 10/2013).
·	TWA: 1800 mg/m³ 10 hours.
	TWA: 1000 ppm 10 hours.
	OSHA PEL (United States, 2/2013).
	TWA: 1800 mg/m³ 8 hours.
	TWA: 1000 ppm 8 hours.
	OSHA PEL 1989 (United States, 3/1989).
	TWA: 1800 mg/m³ 8 hours.
	TWA: 1000 ppm 8 hours.

Appropriate engineering controls

: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls

: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

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Section 8. Exposure controls/personal protection

Hygiene measures

: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period.

Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with sideshields.

Skin protection

Hand protection

: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection

: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear antistatic protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection

: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

: Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Liquefied compressed gas.]

Color : Colorless.

Molecular weight : 44.11 g/mole

Molecular formula : C3-H8

Boiling/condensation point : -161.48°C (-258.7°F) **Melting/freezing point** : -187.6°C (-305.7°F) **Critical temperature** : 96.55°C (205.8°F)

Odor : Odorless.BUT MAY HAVE SKUNK ODOR ADDED.

Odor threshold : Not available.
pH : Not available.

Flash point : Closed cup: -104°C (-155.2°F) Open cup: -104°C (-155.2°F)

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open

flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive

(flammable) limits
Vapor pressure

Vapor density

: Lower: 1.8% Upper: 8.4% : 109 (psig) : 1.6 (Air = 1)

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Section 9. Physical and chemical properties

Specific Volume (ft 3/lb) : 8.6206

Gas Density (lb/ft 3) : 0.116 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.0244 g/l

Partition coefficient: n-

octanol/water

: 1.09

Auto-ignition temperature : 287°C (548.6°F)

Decomposition temperature : Not available.

SADT : Not available.

Viscosity : Not applicable.

Section 10. Stability and reactivity

Reactivity: No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions

: Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld,

braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials: Oxidizers

Hazardous decomposition products

: Under normal conditions of storage and use, hazardous decomposition products should

not be produced.

Hazardous polymerization: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

IDLH : 2100 ppm

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

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Section 11. Toxicological information

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely

routes of exposure

: Not available.

Potential acute health effects

Eye contact
 Inhalation
 No known significant effects or critical hazards.
 Skin contact
 No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate

effects

: Not available.

Potential delayed effects : No

: Not available.

Long term exposure

Potential immediate

effects

: Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
 Carcinogenicity : No known significant effects or critical hazards.
 Mutagenicity : No known significant effects or critical hazards.
 Teratogenicity : No known significant effects or critical hazards.
 Developmental effects : No known significant effects or critical hazards.
 Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

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Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	LogPow	BCF	Potential
Propane	1.09	-	low

Mobility in soil

Soil/water partition coefficient (K_{oc})

: Not available.

Other adverse effects

: No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods

: The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1978	UN1978	UN1978	UN1978	UN1978
UN proper shipping name	PROPANE	PROPANE	PROPANE	PROPANE	PROPANE
Transport hazard class(es)	2.1	2.1	2.1	2.1	2.1
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	Limited quantity Yes. Packaging instruction Passenger aircraft Quantity limitation: Forbidden. Cargo aircraft Quantity limitation: 150 kg Special provisions 19, T50	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). Explosive Limit and Limited Quantity Index 0.125 ERAP Index 3000	-	-	Passenger and Cargo AircraftQuantity limitation: 0 Forbidden Cargo Aircraft Only Quantity limitation: 150 kg

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Propane **Section 14. Transport information** Passenger Carrying **Ship Index** Passenger Carrying Road or Rail Index Forbidden **Special provisions** 29, 42

Special precautions for user : Transport within user's premises: always transport in closed containers that are

upright and secure. Ensure that persons transporting the product know what to do in the

event of an accident or spillage.

Transport in bulk according : Not available.

to Annex II of MARPOL 73/78 and the IBC Code

Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: Not determined

> United States inventory (TSCA 8b): This material is listed or exempted. Clean Air Act (CAA) 112 regulated flammable substances: propane

Clean Air Act Section 112

(b) Hazardous Air **Pollutants (HAPs)** : Not listed

Clean Air Act Section 602

Class I Substances

: Not listed

Clean Air Act Section 602

Class II Substances

: Not listed

DEA List I Chemicals

(Precursor Chemicals)

: Not listed

DEA List II Chemicals

(Essential Chemicals)

: Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard

Sudden release of pressure

Composition/information on ingredients

Name		hazard	Sudden release of pressure	Reactive	(acute) health	Delayed (chronic) health hazard
Propane	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed. **New York** This material is not listed.

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[&]quot;Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

International lists
National inventory

Australia : This material is listed or exempted. : This material is listed or exempted. Canada China : This material is listed or exempted. : This material is listed or exempted. **Europe Japan** : This material is listed or exempted. Malaysia : This material is listed or exempted. **New Zealand** : This material is listed or exempted. **Philippines** : This material is listed or exempted. Republic of Korea : This material is listed or exempted.

Taiwan Canada

WHMIS (Canada) : Class A: Compressed gas.

Class B-1: Flammable gas.

: This material is listed or exempted.

CEPA Toxic substances: This material is not listed.

Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.

Alberta Designated Substances: This material is not listed.

Ontario Designated Substances: This material is not listed.

Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Section 16. Other information

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification	
	Expert judgment Expert judgment	

History

Date of printing : 10/20/2015

Date of issue/Date of : 10/20/2015

revision

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Version : 0.01

Key to abbreviations : ATE = Acute Toxicity Estimate

BCF = Bioconcentration Factor

GHS = Globally Harmonized System of Classification and Labelling of Chemicals

IATA = International Air Transport Association

IBC = Intermediate Bulk Container

IMDG = International Maritime Dangerous Goods

LogPow = logarithm of the octanol/water partition coefficient

MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships,

1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)

UN = United Nations

: Not available.

References

✓ Indicates information that has changed from previously issued version.

Other special considerations

: The information below is given to call attention to the issue of "Naturally occurring radioactive materials". Although Radon-222 levels in the product represented by this MSDS do not present any direct Radon exposure hazard, customers should be aware of the potential for Radon daughter build up within their processing systems, whatever the source of their product streams. Radon-222 is a naturally occurring radioactive gas which can be a contaminant in natural gas. During subsequent processing, Radon tends to be concentrated in Liquefied Petroleum Gas streams and in product streams having a similar boiling point range. Industry experience has shown that this product may contain small amounts of Radon-222 and its radioactive decay products, called Radon "daughters". The actual concentration of Radon-222 and radioactive daughters in the delivered product is dependent on the geographical source of the natural gas and storage time prior to delivery. Process equipment (i.e. lines, filters, pumps and reaction units) may accumulate significant levels of radioactive daughters and show a gamma radiation reading during operation. A potential external radiation hazard exists at or near any pipe valve or vessel containing a Radon enriched stream, or containing internal deposits of radioactive material due to the transmission of gamma radiation through its wall. Field studies reported in the literature have not shown any conditions that subject workers to cumulative exposures in excess of general population limits. Equipment emitting gamma radiation should be presumed to be internally contaminated with alpha emitting decay products which may be a hazard if inhaled or ingested. Protective equipment such as coveralls, gloves, and respirator (NIOSH/MHSA approved for high efficiency particulates and radionuclides, or supplied air) should be worn by personnel entering a vessel or working on contaminated process equipment to prevent skin contamination, ingestion, or inhalation of any residues containing alpha radiation. Airborne contamination may be minimized by handling scale and/or contaminated materials in a wet state.

Notice to reader

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Section 16. Other information

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

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SAFETY DATA SHEET



N-Butane

Section 1. Identification

GHS product identifier

: N-Butane **Chemical name** : Butane

Other means of identification

: n-Butane; Diethyl; Freon 600; Liquefied petroleum gas; LPG; n-C4H10; Butanen;

Butani; Methylethylmethane; UN 1011; UN 1075; A-17; Bu-Gas.

Product use : Synthetic/Analytical chemistry.

: n-Butane; Diethyl; Freon 600; Liquefied petroleum gas; LPG; n-C4H10; Butanen; **Synonym**

Butani; Methylethylmethane; UN 1011; UN 1075; A-17; Bu-Gas.

SDS#

: Airgas USA, LLC and its affiliates Supplier's details

259 North Radnor-Chester Road

Suite 100

Radnor, PA 19087-5283

1-610-687-5253

Emergency telephone number (with hours of operation)

: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard

(29 CFR 1910.1200).

Classification of the : FLAMMABLE GASES - Category 1

GASES UNDER PRESSURE - Liquefied gas substance or mixture

GHS label elements

Hazard pictograms





Signal word : Danger

Hazard statements : Extremely flammable gas.

May form explosive mixtures with air.

Contains gas under pressure; may explode if heated.

May cause frostbite.

May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use.

Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach

suspected leak area with caution.

: Never Put cylinders into unventilated areas of passenger vehicles. Keep away from **Prevention**

heat, sparks, open flames and hot surfaces. - No smoking. Use and store only outdoors

or in a well ventilated place.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all

ignition sources if safe to do so.

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Section 2. Hazards identification

Storage

: Protect from sunlight. Protect from sunlight when ambient temperature exceeds

52°C/125°F. Store in a well-ventilated place.

Disposal

: Not applicable.

Hazards not otherwise

classified

: Liquid can cause burns similar to frostbite.

Section 3. Composition/information on ingredients

: Substance Substance/mixture : Butane **Chemical name**

Other means of

identification

: n-Butane; Diethyl; Freon 600; Liquefied petroleum gas; LPG; n-C4H10; Butanen;

Butani; Methylethylmethane; UN 1011; UN 1075; A-17; Bu-Gas.

CAS number/other identifiers

CAS number : 106-97-8 **Product code** : 001007

Ingredient name	%	CAS number
Butane	100	106-97-8

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact

: Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation

: Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact

Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. In case of contact with liquid, warm frozen tissues slowly with lukewarm water and get medical attention. Do not rub affected area. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion

: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical attention if adverse health effects persist or are severe. Ingestion of liquid can cause burns similar to frostbite. If frostbite occurs, get medical attention. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. As this product rapidly becomes a gas when released, refer to the inhalation section.

Most important symptoms/effects, acute and delayed Potential acute health effects

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Section 4. First aid measures

Eye contact : Liquid can cause burns similar to frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or

frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion: Ingestion of liquid can cause burns similar to frostbite.

Over-exposure signs/symptoms

Eye contact: Adverse symptoms may include the following:

frostbite

Inhalation : No specific data.

Skin contact: Adverse symptoms may include the following:

frostbite

Ingestion: Adverse symptoms may include the following:

frostbite

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large

quantities have been ingested or inhaled.

Specific treatments: No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may

be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing

media

: Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing

media

: None known.

Specific hazards arising from the chemical

: Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Gas may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back, causing fire or explosion.

Hazardous thermal decomposition products

Decomposition products may include the following materials:

carbon dioxide carbon monoxide

Special protective actions for fire-fighters

: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters

: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. For incidents involving large quantities, thermally insulated undergarments and thick textile or leather gloves should be worn.

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Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

: Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders:

If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For nonemergency personnel".

Environmental precautions

: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill

: Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures

: Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Do not get in eyes or on skin or clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosionproof electrical (ventilating, lighting and material handling) equipment. Use only nonsparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene

: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

including any incompatibilities

Conditions for safe storage, : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

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Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Butane	ACGIH TLV (United States, 3/2012). TWA: 1000 ppm 8 hours. NIOSH REL (United States, 1/2013). TWA: 1900 mg/m³ 10 hours. TWA: 800 ppm 10 hours. OSHA PEL 1989 (United States, 3/1989). TWA: 1900 mg/m³ 8 hours. TWA: 800 ppm 8 hours.

Appropriate engineering controls

: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls

: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period.

Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with sideshields.

Skin protection Hand protection

: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. If contact with the liquid is possible, insulated gloves suitable for low temperatures should be worn. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection

: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear antistatic protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection

: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

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Section 8. Exposure controls/personal protection

Respiratory protection

: Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Liquefied compressed gas.]

Color Colorless. Molecular weight : 58.14 g/mole Molecular formula : C4-H10

Boiling/condensation point : -0.5°C (31.1°F) **Melting/freezing point** : -138°C (-216.4°F) Critical temperature : 151.85°C (305.3°F)

Odor Odorless. **Odor threshold** Not available. pH : Not available.

: Closed cup: -60°C (-76°F) Flash point

Burning time : Not applicable. **Burning rate** : Not applicable. : Not available. **Evaporation rate**

Extremely flammable in the presence of the following materials or conditions: open Flammability (solid, gas)

flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive

: Lower: 1.8% Upper: 8.4% (flammable) limits Vapor pressure : 16.3 (psig) Vapor density 2.1 (Air = 1)Specific Volume (ft 3/lb) : 6.435

Gas Density (lb/ft 3) : 0.1554 Relative density : Not applicable. **Solubility** Not available. Solubility in water : 0.061 q/l

Partition coefficient: n-

octanol/water

2.89

Auto-ignition temperature : 365°C (689°F) **Decomposition temperature** : Not available. **SADT** : Not available. **Viscosity** : Not applicable.

Section 10. Stability and reactivity

Reactivity No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous

reactions

: Under normal conditions of storage and use, hazardous reactions will not occur.

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Section 10. Stability and reactivity

Conditions to avoid

: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow gas to accumulate in low or confined areas.

Incompatibility with various substances

: Extremely reactive or incompatible with the following materials: oxidizing materials.

Hazardous decomposition products

: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Butane	LC50 Inhalation Vapor	Rat	658000 mg/m ³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure

: Not available.

Potential acute health effects

Eye contactInhalationLiquid can cause burns similar to frostbite.InhalationNo known significant effects or critical hazards.

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Section 11. Toxicological information

Skin contact : Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or

frostbite.

Ingestion: Ingestion of liquid can cause burns similar to frostbite.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following:

frostbite

Inhalation : No specific data.

Skin contact: Adverse symptoms may include the following:

frostbite

Ingestion: Adverse symptoms may include the following:

frostbite

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate : Not available.

effects

Potential delayed effects : Not available.

Long term exposure

Potential immediate : Not available.

effects

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
 Carcinogenicity : No known significant effects or critical hazards.
 Mutagenicity : No known significant effects or critical hazards.
 Teratogenicity : No known significant effects or critical hazards.
 Developmental effects : No known significant effects or critical hazards.
 Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

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Section 12. Ecological information

Product/ingredient name	LogPow	BCF	Potential
Butane	2.89	-	low

Mobility in soil

Soil/water partition coefficient (K_{oc})

: Not available.

Other adverse effects

: No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods

The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1011	UN1011	UN1011	UN1011	UN1011
UN proper shipping name	BUTANE	BUTANE	BUTANE	BUTANE	BUTANE
Transport hazard class(es)	2.1	2.1	2.1	2.1	2.1
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	Limited quantity Yes. Packaging instruction Passenger aircraft Quantity limitation: Forbidden. Cargo aircraft Quantity limitation: 150 kg Special provisions 19, T50	Explosive Limit and Limited Quantity Index 0.125 ERAP Index 3000 Passenger Carrying Ship Index Forbidden Passenger Carrying Road or Rail Index Forbidden Special provisions 29			Passenger and Cargo AircraftQuantity limitation: 0 Forbidden Cargo Aircraft Only Quantity limitation: 150 kg

[&]quot;Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

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Section 14. Transport information

Special precautions for user : Transport within user's premises: always transport in closed containers that are

upright and secure. Ensure that persons transporting the product know what to do in the

event of an accident or spillage.

Transport in bulk according : Not available.

to Annex II of MARPOL 73/78 and the IBC Code

Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: Not determined

> United States inventory (TSCA 8b): This material is listed or exempted. Clean Air Act (CAA) 112 regulated flammable substances: Butane

Clean Air Act Section 112

(b) Hazardous Air **Pollutants (HAPs)** : Not listed

Clean Air Act Section 602

Class I Substances

: Not listed

Clean Air Act Section 602

Class II Substances

: Not listed

DEA List I Chemicals

(Precursor Chemicals)

: Not listed

DEA List II Chemicals

: Not listed

(Essential Chemicals) **SARA 302/304**

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard

Sudden release of pressure

Composition/information on ingredients

Name	%		Sudden release of pressure		Immediate (acute) health hazard	Delayed (chronic) health hazard
Butane	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed. **New York** : This material is not listed. : This material is listed. **New Jersey Pennsylvania** : This material is listed.

: This material is listed or exempted. **Canada inventory**

International regulations

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Section 15. Regulatory information

International lists

: Australia inventory (AICS): This material is listed or exempted.

China inventory (IECSC): This material is listed or exempted.

Japan inventory: This material is listed or exempted.

Korea inventory: This material is listed or exempted.

Malaysia Inventory (EHS Register): Not determined.

New Zealand Inventory of Chemicals (NZIoC): This material is listed or exempted.

Philippines inventory (PICCS): This material is listed or exempted.

Taiwan inventory (CSNN): Not determined.

Chemical Weapons

Convention List Schedule

I Chemicals

Chemical Weapons

Convention List Schedule

II Chemicals

Chemical Weapons
Convention List Schedule

III Chemicals

: Not listed

: Not listed

: Not listed

Canada

WHMIS (Canada) : (

: Class A: Compressed gas. Class B-1: Flammable gas.

CEPA Toxic substances: This material is not listed.

Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.

Alberta Designated Substances: This material is not listed. Ontario Designated Substances: This material is not listed. Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements

: Class A: Compressed gas. Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Section 16. Other information

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

<u>History</u>

Date of printing : 5/7/2015.

Date of issue/Date of : 5/7/2015.

revision

Date of previous issue : 10/15/2014.

Version : 0.03

Key to abbreviations : ATE = Acute Toxicity Estimate

BCF = Bioconcentration Factor

GHS = Globally Harmonized System of Classification and Labelling of Chemicals

IATA = International Air Transport Association

IBC = Intermediate Bulk Container

IMDG = International Maritime Dangerous Goods

LogPow = logarithm of the octanol/water partition coefficient

MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships,

1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)

UN = United NationsACGIH – American Conference of Governmental Industrial

Hygienists

AIHA - American Industrial Hygiene Association

CAS - Chemical Abstract Services

CEPA – Canadian Environmental Protection Act

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act

(EPA)

CFR – United States Code of Federal Regulations

CPR – Controlled Products Regulations DSL – Domestic Substances List GWP – Global Warming Potential

IARC – International Agency for Research on Cancer ICAO – International Civil Aviation Organisation

Inh – Inhalation

LC – Lethal concentration LD – Lethal dosage

NDSL – Non-Domestic Substances List

NIOSH - National Institute for Occupational Safety and Health

TDG - Canadian Transportation of Dangerous Goods Act and Regulations

TLV - Threshold Limit Value

TSCA - Toxic Substances Control Act

WEEL - Workplace Environmental Exposure Level

WHMIS - Canadian Workplace Hazardous Material Information System

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

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Section 16. Other information

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

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SAFETY DATA SHEET



Nitrogen

Section 1. Identification

GHS product identifier : Nitrogen **Chemical name** : nitrogen

Other means of identification **Product use**

nitrogen (dot); nitrogen gas; Nitrogen NF, Nitrogen FG

: Synthetic/Analytical chemistry.

: nitrogen (dot); nitrogen gas; Nitrogen NF, Nitrogen FG **Synonym**

SDS# 001040

: Airgas USA, LLC and its affiliates Supplier's details 259 North Radnor-Chester Road

Suite 100

Radnor, PA 19087-5283

1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard

(29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms



Signal word Warning

Contains gas under pressure; may explode if heated. **Hazard statements**

May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use.

Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible

materials of construction.

Prevention : Not applicable. Response : Not applicable.

: Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-**Storage**

ventilated place.

Disposal : Not applicable.

Hazards not otherwise : In addition to any other important health or physical hazards, this product may displace classified

oxygen and cause rapid suffocation.

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Section 3. Composition/information on ingredients

Substance/mixture : Substance
Chemical name : nitrogen

Other means of identification

: nitrogen (dot); nitrogen gas; Nitrogen NF, Nitrogen FG

CAS number/other identifiers

CAS number : 7727-37-9 **Product code** : 001040

Ingredient name	%	CAS number
Nitrogen	100	7727-37-9

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10

minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If

not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar,

tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical

surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and

shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean

shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact: Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact
 Contact with rapidly expanding gas may cause burns or frostbite.
 Frostbite
 Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

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Section 4. First aid measures

Specific treatments

- : No specific treatment.
- **Protection of first-aiders**
- : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media

: Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media

: None known.

Specific hazards arising from the chemical

: Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.

Hazardous thermal decomposition products : Decomposition products may include the following materials: nitrogen oxides

Special protective actions for fire-fighters

: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers

Special protective equipment for fire-fighters Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders: If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For nonemergency personnel".

Environmental precautions

: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill

: Immediately contact emergency personnel. Stop leak if without risk.

Large spill

: Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures

: Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

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Section 7. Handling and storage

Advice on general occupational hygiene

: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Nitrogen	Oxygen Depletion [Asphyxiant]

Appropriate engineering controls

: Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls

: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period.

Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with sideshields.

Skin protection

Hand protection

: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection

: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection

: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection

: Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

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Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Compressed gas.]

Color : Colorless. Molecular weight : 28.02 g/mole

Molecular formula : N2

Boiling/condensation point : -196°C (-320.8°F) **Melting/freezing point** : -210.01°C (-346°F) **Critical temperature** : -146.95°C (-232.5°F)

Odor : Odorless. **Odor threshold** : Not available. pH : Not available.

Flash point : [Product does not sustain combustion.]

Burning time Not applicable. **Burning rate** : Not applicable. **Evaporation rate** : Not available. Flammability (solid, gas) : Not available. Lower and upper explosive : Not available.

(flammable) limits

Vapor pressure : Not available.

Vapor density : 0.967 (Air = 1) Liquid Density@BP: 50.46 lb/ft3 (808.3 kg/m3)

Specific Volume (ft ³/lb) 13.8889 : 0.072 Gas Density (lb/ft 3)

Relative density : Not applicable. **Solubility** : Not available. : Not available. Solubility in water

Partition coefficient: n-

octanol/water

: 0.67

Auto-ignition temperature : Not available. **Decomposition temperature** : Not available. **SADT** : Not available. **Viscosity** : Not applicable.

Section 10. Stability and reactivity

: No specific test data related to reactivity available for this product or its ingredients. Reactivity

Chemical stability : The product is stable.

Possibility of hazardous reactions

: Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : No specific data.

Incompatible materials : No specific data.

Hazardous decomposition

products

: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

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Section 10. Stability and reactivity

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely

routes of exposure

: Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact: Contact with rapidly expanding gas may cause burns or frostbite.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate : Not available.

effects

Potential delayed effects : Not available.

Long term exposure

Potential immediate : Not available.

effects

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

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Section 11. Toxicological information

Mutagenicity: No known significant effects or critical hazards.Teratogenicity: No known significant effects or critical hazards.Developmental effects: No known significant effects or critical hazards.Fertility effects: No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	LogPow	BCF	Potential
Nitrogen	0.67	-	low

Mobility in soil

Soil/water partition coefficient (Koc)

: Not available.

Other adverse effects

: No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods

: The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1066	UN1066	UN1066	UN1066	UN1066
UN proper shipping name	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED	NITROGEN, COMPRESSED
Transport hazard class(es)	2.2	2.2	2.2	2.2	2.2

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Section 14. Transport information

Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	Limited quantity Yes. Packaging instruction Passenger aircraft Quantity limitation: 75 kg Cargo aircraft Quantity limitation: 150 kg	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). Explosive Limit and Limited Quantity Index 0.125 Passenger Carrying Road or Rail Index 75	-	-	Passenger and Cargo AircraftQuantity Iimitation: 75 kg Cargo Aircraft Only Quantity limitation: 150 kg

[&]quot;Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : Transport within user's premises: always transport in closed containers that are

upright and secure. Ensure that persons transporting the product know what to do in the

event of an accident or spillage.

Transport in bulk according : Not available. to Annex II of MARPOL

73/78 and the IBC Code

Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: This material is listed or exempted.

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act Section 112

(b) Hazardous Air **Pollutants (HAPs)** : Not listed

Clean Air Act Section 602

Class I Substances

: Not listed

Clean Air Act Section 602

Class II Substances

: Not listed

DEA List I Chemicals

: Not listed

(Precursor Chemicals)

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

: Sudden release of pressure Classification

Composition/information on ingredients

Name	%	hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Nitrogen	100	No.	Yes.	No.	No.	No.

Date of issue/Date of revision 8/10 : 5/26/2016 : 8/7/2015 Version : 0.02 Date of previous issue

Section 15. Regulatory information

State regulations

Massachusetts: This material is listed.New York: This material is not listed.New Jersey: This material is listed.Pennsylvania: This material is listed.

International regulations

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : Not determined.

Malaysia : Not determined.

New Zealand: This material is listed or exempted.Philippines: This material is listed or exempted.Republic of Korea: This material is listed or exempted.Taiwan: This material is listed or exempted.

Canada

WHMIS (Canada) : Class A: Compressed gas.

CEPA Toxic substances: This material is not listed.

Canadian ARET: This material is not listed. **Canadian NPRI**: This material is not listed.

Alberta Designated Substances: This material is not listed. Ontario Designated Substances: This material is not listed. Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Date of issue/Date of revision : 5/26/2016 Date of previous issue : 8/7/2015 Version : 0.02 9/10

Section 16. Other information

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Press. Gas Comp. Gas, H280	Expert judgment

History

Date of printing : 5/26/2016 Date of issue/Date of : 5/26/2016

revision

Date of previous issue : 8/7/2015 Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate

BCF = Bioconcentration Factor

GHS = Globally Harmonized System of Classification and Labelling of Chemicals

IATA = International Air Transport Association

IBC = Intermediate Bulk Container

IMDG = International Maritime Dangerous Goods

LogPow = logarithm of the octanol/water partition coefficient

MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships,

1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)

UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot quarantee that these are the only hazards that exist.

Date of issue/Date of revision : 5/26/2016 Date of previous issue : 8/7/2015 Version : 0.02 10/10



Material Name: Diesel Fuel, All Types

SDS No. 9909 US GHS

Synonyms: Ultra Low Sulfur Diesel; Low Sulfur Diesel; No. 2 Diesel; Motor Vehicle Diesel Fuel; Non-

Road Diesel Fuel; Locomotive/Marine Diesel Fuel

Section 1 - Product and Company Identification

Manufacturer Information

Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095-0961 Phone: 732-750-6000 Corporate EHS Emergency #800-424-9300 CHEMTREC

www.hess.com (Environment, Health, Safety Internet Website)

Section 2 - Hazards Identification

GHS Classification:

Flammable Liquids - Category 3

Skin Corrosion/Irritation - Category 2

Germ Cell Mutagenicity - Category 2

Carcinogenicity - Category 2

Specific Target Organ Toxicity (Single Exposure) - Category 3 (respiratory irritation, narcosis)

Aspiration Hazard - Category 1

Hazardous to the Aquatic Environment, Acute Hazard – Category 3

GHS LABEL ELEMENTS

Symbol(s)







Signal Word

DANGER

Hazard Statements

Flammable liquid and vapor.

Causes skin irritation.

Suspected of causing genetic defects.

Suspected of causing cancer.

May cause respiratory irritation.

May cause drowsiness or dizziness.

May be fatal if swallowed and enters airways.

Harmful to aquatic life.

Precautionary Statements

Prevention

Keep away from heat/sparks/open flames/hot surfaces. No smoking

Keep container tightly closed.

Ground/bond container and receiving equipment.

Material Name: Diesel Fuel, All Types

SDS No. 9909

Use explosion-proof electrical/ventilating/lighting/equipment.

Use only non-sparking tools.

Take precautionary measures against static discharge.

Wear protective gloves/protective clothing/eye protection/face protection.

Wash hands and forearms thoroughly after handling.

Obtain special instructions before use.

Do not handle until all safety precautions have been read and understood.

Avoid breathing fume/mist/vapours/spray.

Response

In case of fire: Use water spray, fog or foam to extinguish.

IF ON SKIN (or hair): Wash with plenty of soap and water. Remove/Take off immediately all contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical advice/attention.

IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell.

If swallowed: Immediately call a poison center or doctor. Do NOT induce vomiting.

IF exposed or concerned: Get medical advice/attention.

Storage

Store in a well-ventilated place. Keep cool.

Keep container tightly closed.

Store locked up.

Disposal

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 3 - Composition / Information on Ingredients * * *

CAS#	Component	Percent
68476-34-6	Fuels, diesel, no. 2	100
91-20-3	Naphthalene	<0.1

A complex mixture of hydrocarbons with carbon numbers in the range C9 and higher.

* * * Section 4 - First Aid Measures * * *

First Aid: Eyes

In case of contact with eyes, immediately flush with clean, low-pressure water for at least 15 min. Hold eyelids open to ensure adequate flushing. Seek medical attention.

First Aid: Skin

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or with waterless hand cleanser. Obtain medical attention if irritation or redness develops. Thermal burns require immediate medical attention depending on the severity and the area of the body burned.

First Aid: Ingestion

DO NOT INDUCE VOMITING. Do not give liquids. Obtain immediate medical attention. If spontaneous vomiting occurs, lean victim forward to reduce the risk of aspiration. Monitor for breathing difficulties. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

Page 2 of 10	Revision Date 8/30/12

Material Name: Diesel Fuel, All Types SDS No. 9909

First Aid: Inhalation

Remove person to fresh air. If person is not breathing, provide artificial respiration. If necessary, provide additional oxygen once breathing is restored if trained to do so. Seek medical attention immediately.

* * * Section 5 - Fire Fighting Measures * * *

General Fire Hazards

See Section 9 for Flammability Properties.

Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back. Runoff to sewer may cause fire or explosion hazard.

Hazardous Combustion Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Extinguishing Media

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, and other gaseous agents.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

Unsuitable Extinguishing Media

None

Fire Fighting Equipment/Instructions

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment. Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing. Isolate area around container involved in fire. Cool tanks, shells, and containers exposed to fire and excessive heat with water. For massive fires the use of unmanned hose holders or monitor nozzles may be advantageous to further minimize personnel exposure. Major fires may require withdrawal, allowing the tank to burn. Large storage tank fires typically require specially trained personnel and equipment to extinguish the fire, often including the need for properly applied fire fighting foam.

* * * Section 6 - Accidental Release Measures * * *

Recovery and Neutralization

Carefully contain and stop the source of the spill, if safe to do so.

Materials and Methods for Clean-Up

Take up with sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal. Caution, flammable vapors may accumulate in closed containers.

Emergency Measures

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

Page 3 of 10	Revision Date 8/30/12

Material Name: Diesel Fuel, All Types SDS No. 9909

Personal Precautions and Protective Equipment

Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

Environmental Precautions

Protect bodies of water by diking, absorbents, or absorbent boom, if possible. Do not flush down sewer or drainage systems, unless system is designed and permitted to handle such material. The use of fire fighting foam may be useful in certain situations to reduce vapors. The proper use of water spray may effectively disperse product vapors or the liquid itself, preventing contact with ignition sources or areas/equipment that require protection.

Prevention of Secondary Hazards

None

Section 7 - Handling and Storage

Handling Procedures

Handle as a combustible liquid. Keep away from heat, sparks, excessive temperatures and open flame! No smoking or open flame in storage, use or handling areas. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

Special slow load procedures for "switch loading" must be followed to avoid the static ignition hazard that can exist when higher flash point material (such as fuel oil) is loaded into tanks previously containing low flash point products (such as this product) - see API Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents."

Storage Procedures

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. The cleaning of tanks previously containing this product should follow API Recommended Practice (RP) 2013 "Cleaning Mobile Tanks In Flammable and Combustible Liquid Service" and API RP 2015 "Cleaning Petroleum Storage Tanks."

Incompatibilities

Keep away from strong oxidizers.

Section 8 - Exposure Controls / Personal Protection

Component Exposure Limits

Fuels, diesel, no. 2 (68476-34-6)

100 mg/m3 TWA (inhalable fraction and vapor, as total hydrocarbons, listed under Diesel fuel) Skin - potential significant contribution to overall exposure by the cutaneous route (listed under Diesel fuel)

Material Name: Diesel Fuel, All Types SDS No. 9909

Naphthalene (91-20-3)

ACGIH: 10 ppm TWA 15 ppm STEL

Skin - potential significant contribution to overall exposure by the cutaneous route

OSHA: 10 ppm TWA; 50 mg/m3 TWA NIOSH: 10 ppm TWA; 50 mg/m3 TWA 15 ppm STEL; 75 mg/m3 STEL

Engineering Measures

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

Personal Protective Equipment: Respiratory

A NIOSH/MSHA-approved air-purifying respirator with organic vapor cartridges or canister may be permissible under certain circumstances where airborne concentrations are or may be expected to exceed exposure limits or for odor or irritation. Protection provided by air-purifying respirators is limited.

Use a positive pressure, air-supplied respirator if there is a potential for uncontrolled release, exposure levels are not known, in oxygen-deficient atmospheres, or any other circumstance where an air-purifying respirator may not provide adequate protection.

Personal Protective Equipment: Hands

Gloves constructed of nitrile, neoprene, or PVC are recommended.

Personal Protective Equipment: Eyes

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

Personal Protective Equipment: Skin and Body

Chemical protective clothing such as of E.I. DuPont TyChem®, Saranex® or equivalent recommended based on degree of exposure. Note: The resistance of specific material may vary from product to product as well as with degree of exposure. Consult manufacturer specifications for further information.

Section 9 - Physical & Chemical Properties

Appearance: Clear, straw-yellow. Odor: Mild, petroleum distillate odor

Physical State: Liquid pH: ND **Vapor Pressure:** 0.009 psia @ 70 °F (21 °C) Vapor Density: >1.0 **Boiling Point:** 320 to 690 °F (160 to 366 °C) Melting Point: ND

Solubility (H2O): Negligible **Specific Gravity:** 0.83-0.876 @ 60°F (16°C)

Evaporation Rate: Slow; varies with conditions VOC: Octanol/H2O Coeff.: Percent Volatile: 100% ND Flash Point: >125 °F (>52 °C) minimum Flash Point Method: PMCC

Lower Flammability Limit 0.6 **Upper Flammability Limit** 7.5 (UFL):

(LFL):

Burning Rate: ND Auto Ignition: 494°F (257°C)

Section 10 - Chemical Stability & Reactivity Information

Chemical Stability

This is a stable material.

Hazardous Reaction Potential

Will not occur.

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Material Name: Diesel Fuel, All Types SDS No. 9909

Conditions to Avoid

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources.

Incompatible Products

Keep away from strong oxidizers.

Hazardous Decomposition Products

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).

Section 11 - Toxicological Information

Acute Toxicity

A: General Product Information

Harmful if swallowed.

B: Component Analysis - LD50/LC50

Naphthalene (91-20-3)

Inhalation LC50 Rat >340 mg/m3 1 h; Oral LD50 Rat 490 mg/kg; Dermal LD50 Rat >2500 mg/kg; Dermal LD50 Rabbit >20 g/kg

Potential Health Effects: Skin Corrosion Property/Stimulativeness

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are repeatedly exposed.

Potential Health Effects: Eye Critical Damage/ Stimulativeness

Contact with eyes may cause mild irritation.

Potential Health Effects: Ingestion

Ingestion may cause gastrointestinal disturbances, including irritation, nausea, vomiting and diarrhea, and central nervous system (brain) effects similar to alcohol intoxication. In severe cases, tremors, convulsions, loss of consciousness, coma, respiratory arrest, and death may occur.

Potential Health Effects: Inhalation

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

WARNING: the burning of any hydrocarbon as a fuel in an area without adequate ventilation may result in hazardous levels of combustion products, including carbon monoxide, and inadequate oxygen levels, which may cause unconsciousness, suffocation, and death.

Respiratory Organs Sensitization/Skin Sensitization

This product is not reported to have any skin sensitization effects.

Generative Cell Mutagenicity

This material has been positive in a mutagenicity study.

Carcinogenicity

A: General Product Information

Suspected of causing cancer.

Material Name: Diesel Fuel, All Types

SDS No. 9909

Studies have shown that similar products produce skin tumors in laboratory animals following repeated applications without washing or removal. The significance of this finding to human exposure has not been determined. Other studies with active skin carcinogens have shown that washing the animal's skin with soap and water between applications reduced tumor formation.

B: Component Carcinogenicity

Fuels, diesel, no. 2 (68476-34-6)

ACGIH: A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans (listed under Diesel

fuel)

Naphthalene (91-20-3)

ACGIH: A4 - Not Classifiable as a Human Carcinogen

NTP: Reasonably Anticipated To Be A Human Carcinogen (Possible Select Carcinogen)

IARC: Monograph 82 [2002] (Group 2B (possibly carcinogenic to humans))

Reproductive Toxicity

This product is not reported to have any reproductive toxicity effects.

Specified Target Organ General Toxicity: Single Exposure

This product is not reported to have any specific target organ general toxicity single exposure effects.

Specified Target Organ General Toxicity: Repeated Exposure

This product is not reported to have any specific target organ general toxicity repeat exposure effects.

Aspiration Respiratory Organs Hazard

The major health threat of ingestion occurs from the danger of aspiration (breathing) of liquid drops into the lungs, particularly from vomiting. Aspiration may result in chemical pneumonia (fluid in the lungs), severe lung damage, respiratory failure and even death.

Section 12 - Ecological Information

Ecotoxicity

A: General Product Information

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations.

B: Component Analysis - Ecotoxicity - Aquatic Toxicity

Fuels, diesel, no. 2 (68476-34-6)

96 Hr LC50 Oncorhynchus mykiss

Conditions Test & Species

96 Hr LC50 Pimephales promelas 35 mg/L [flowthrough]

Naphthalene (91-20-3)

Test & Species Conditions

96 Hr LC50 Pimephales promelas 5.74-6.44 mg/L

> [flow-through] 1.6 mg/L [flow-

through] 96 Hr LC50 Oncorhynchus mykiss 0.91-2.82 mg/L

[static]

96 Hr LC50 Pimephales promelas 1.99 mg/L [static]

Material Name: Diesel Fuel, All Types

SDS No. 9909

96 Hr LC50 Lepomis macrochirus 31.0265 mg/L

[static]

72 Hr EC50 Skeletonema costatum
48 Hr LC50 Daphnia magna
2.16 mg/L
48 Hr EC50 Daphnia magna
1.96 mg/L [Flow

through]

48 Hr EC50 Daphnia magna 1.09 - 3.4 mg/L

[Static]

Persistence/Degradability

No information available.

Bioaccumulation

No information available.

Mobility in Soil

No information available.

* * Section 13 - Disposal Considerations * * *

Waste Disposal Instructions

See Section 7 for Handling Procedures. See Section 8 for Personal Protective Equipment recommendations.

Disposal of Contaminated Containers or Packaging

Dispose of contents/container in accordance with local/regional/national/international regulations.

* * * Section 14 - Transportation Information * * *

DOT Information

Shipping Name: Diesel Fuel

NA #: 1993 Hazard Class: 3 Packing Group: III

Placard:



* * * Section 15 - Regulatory Information * * *

Regulatory Information

Component Analysis

This material contains one or more of the following chemicals required to be identified under SARA Section 302 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65) and/or CERCLA (40 CFR 302.4).

Naphthalene (91-20-3)

CERCLA: 100 lb final RQ; 45.4 kg final RQ

SARA Section 311/312 - Hazard Classes

Acute Health Chronic Health Fire Sudden Release of Pressure Reactive
X X -- -- ---

Material Name: Diesel Fuel, All Types SDS No. 9909

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product may contain listed chemicals below the de minimis levels which therefore are not subject to the supplier notification requirements of Section 313 of the Emergency Planning and Community Right- To-Know Act (EPCRA) of 1986 and of 40 CFR 372. If you may be required to report releases of chemicals listed in 40 CFR 372.28, you may contact Hess Corporate Safety if you require additional information regarding this product.

State Regulations

Component Analysis - State

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
Fuels, diesel, no. 2	68476-34-6	No	No	No	Yes	No	No
Naphthalene	91-20-3	Yes	Yes	Yes	Yes	Yes	No

The following statement(s) are provided under the California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):

WARNING! This product contains a chemical known to the state of California to cause cancer.

Component Analysis - WHMIS IDL

No components are listed in the WHMIS IDL.

Additional Regulatory Information

Component Analysis - Inventory

Component	CAS#	TSCA	CAN	EEC
Fuels, diesel, no. 2	68476-34-6	Yes	DSL	EINECS
Naphthalene	91-20-3	Yes	DSL	EINECS

Section 16 - Other Information

NFPA® Hazard Rating

1 Health 2 Fire

Reactivity



HMIS® Hazard Rating

Health Fire

Slight

2 Moderate

Physical

Minimal *Chronic

Material Name: Diesel Fuel, All Types SDS No. 9909

Key/Legend

ACGIH = American Conference of Governmental Industrial Hygienists; ADG = Australian Code for the Transport of Dangerous Goods by Road and Rail; ADR/RID = European Agreement of Dangerous Goods by Road/Rail; AS = Standards Australia; DFG = Deutsche Forschungsgemeinschaft; DOT = Department of Transportation; DSL = Domestic Substances List; EEC = European Economic Community; EINECS = European Inventory of Existing Commercial Chemical Substances; ELINCS = European List of Notified Chemical Substances; EU = European Union; HMIS = Hazardous Materials Identification System; IARC = International Agency for Research on Cancer; IMO = International Maritime Organization; IATA = International Air Transport Association; MAK = Maximum Concentration Value in the Workplace; NDSL = Non-Domestic Substances List; NFPA = National Toxicology Program; STEL = Short-term Exposure Limit; TDG = Transportation of Dangerous Goods; TLV = Threshold Limit Value; TSCA = Toxic Substances Control Act; TWA = Time Weighted Average

Literature References

None

Other Information

Information presented herein has been compiled from sources considered to be dependable, and is accurate and reliable to the best of our knowledge and belief, but is not guaranteed to be so. Since conditions of use are beyond our control, we make no warranties, expressed or implied, except those that may be contained in our written contract of sale or acknowledgment.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material, even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in their use of the material.

End of Sheet



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PUBLIC	APPENDIX COVERSHEET

H.2 – Hazardous Release List

Document Number:	Description:	Revision:	Appendix:
N/A	Hazardous Release List is included in the Hazard Analysis Report in Appendix H.3	N/A	Public



	USAI-PE-SRREG-00-000013-000-B
RR13 APPENDIX TABLE OF CONTENTS	14 April 2017
	REVISION: 1
PUBLIC	APPENDIX COVERSHEET

H.3 – Hazard Analysis Reports

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-HSE-RTA-DOC-00004	Hazard Analysis Report	0	Public



Hazard Analysis Report

DOCUMENT NUMBER: AKLNG-4030-HSE-RTA-DOC-00004





Hazard Analysis Report



Rev No.	Issue Purpose:	Date:	Ву	CHK	APP
Α	Issued for Information	April 12, 2017	HES	JMW	PJS

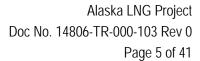


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1 INTRODUCTION

The Alaska Gasline Development Corporation (Applicant) plans to construct one integrated liquefied natural gas (LNG) Project (Project) with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular from the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce and for in-state deliveries of natural gas.

The new Liquefaction Facility would be constructed on the eastern shore of Cook Inlet just south of the existing Agrium fertilizer plant on the Kenai Peninsula, approximately 3 miles southwest of Nikiski and 8.5 miles north of Kenai. The Liquefaction Facility would include the structures, equipment, underlying access rights and all other associated systems for final processing and liquefaction of natural gas, as well as storage and loading of LNG, including terminal facilities and auxiliary marine vessels used to support Marine Terminal operations (excluding LNG carriers [LNGCs]). The Liquefaction Facility would include three liquefaction trains combining to process up to approximately 20 million metric tons per annum (MMTPA) of LNG. Two 240,000-cubic-meter tanks would be constructed to store the LNG. The Liquefaction Facility would be capable of accommodating two LNGCs. The size of LNGCs that the Liquefaction Facility would accommodate would range between 125,000–216,000-cubic-meter vessels.

2 REPORT PURPOSE

The purpose of this report is to describe LNG single accidental leak sources and associated design spill rates as well as other process assumptions used in performing LNG exclusion zone analysis in accordance with the requirements of 49 CFR 193.2057 and 49 CFR 193.2059. The report will also describe the refrigerant, toxics and asphyxiation hazard analysis performed and the associated results to demonstrate compliance with the requirements of 49 CFR 193 and NFPA 59A (2001) Section 2.1.1.d. for the Project.

3 HAZARDOUS MATERIALS

Natural gas entering the Liquefaction Facility will be liquefied in three liquefaction trains using three Propane Pre-Cooled C3 MR Air Products and Chemicals, Inc. (APCI) Liquefaction Trains. The LNG is non-toxic, but it is flammable.

The liquefaction trains include a series of refrigeration loops using nitrogen, methane, ethane and propane. Nitrogen, ethane and propane will be stored as liquid located outside the trains.

A Fractionation System will be provided to produce ethane and propane make-up for the refrigerant circuits, liquefied petroleum gas (LPG) reinjection to the Liquefaction System and a condensate byproduct to be trucked out. For the purpose of this analysis, LPG and condensate are grouped as heavy hydrocarbon (HHC). The Fractionation System will consist of a Deethanizer, a Depropanizer, a Debutanizer and associated equipment.



4 SPILL CONTAINMENT SIZING

LNG, refrigerant and other hazardous liquid spill containment sizing for storage and process areas will be sized in accordance with 49 CFR Part 193 and NFPA 59A (2001) and is outlined in the Hydrocarbon Spill Containment Sizing Report, Document Number USAL-CB-FRZZZ-00-000005-000. The LNG impoundment basins that will be installed at the Liquefaction Facility will be of pre-cast concrete design. Spills of LNG will flow along the concrete trenches and troughs located alongside and beneath liquid pipelines. The trenches will enter the basins above the required impoundment volume. Spill collection grading and curbing is provided throughout the Liquefaction Facility and is illustrated in the Spill Containment Drawings included in Appendix S.3 of Resource Report 13.

5 METHODOLOGY

5.1 Exclusion Zone Requirements

An "Exclusion Zone" is defined as an area surrounding an LNG facility in which an operator or government agency legally controls all activities in accordance with 49 CFR 193.2057 and 49 CFR 193.2059 for as long as the facility is in operation.

5.2 Thermal Radiation Exclusion Zone Requirements

Federal Code 49 CFR 193.2057 requires that "Each LNG container and LNG transfer system must have a thermal Exclusion Zone in accordance with section 2.2.3.2 of NFPA 59A (incorporated by reference)". Section 2.2.3.2 of NFPA 59A (2001 edition) requires that provisions shall be made to minimize the possibility of the damaging effects of fire reaching beyond a property line that can be built upon and that would result in a distinct hazard:

- 1,600 Btu/ft²-hr (5,000 W/m²) at a property line that can be built upon for ignition of a design spill (as specified in 2.2.3.5),
- 1,600 Btu/ft²-hr (5,000 W/m²) at the nearest point located outside the owner's property line that, at the time of plant siting, is used for outdoor assembly by groups of 50 or more persons for a fire over an impounding area containing a volume, V, of LNG determined in accordance with 2.2.2.1,
- 3,000 Btu/ft²-hr (9,000 W/m²) at the nearest point of the building or structure outside the owner's property line that is in existence at the time of plant siting and used for occupancies classified by NFPA 101®, Life Safety Code®, as assembly, educational, health care, detention and correction or residential for a fire over an impounding area containing a volume, V, of LNG determined in accordance with 2.2.2.1, and
- 10,000 Btu/ft²-hr (30,000 W/m²) at a property line that can be built upon for a fire over an impounding area containing a volume, V, of LNG determined in accordance with 2.2.2.1.

This section of NFPA 59A and also 49 CFR 193.2057 require that thermal radiation distances be determined by using the model described in Gas Research Institute report GRI 0176, "LNGFIRE: A Thermal Radiation Model for LNG Fires".



CH-IV used LNGFIRE3 to calculate the thermal radiation Exclusion Zones associated with the LNG impoundment basins to demonstrate compliance with 49 CFR 193.2057.

5.3 Vapor Dispersion Exclusion Zone Requirements

Federal Code 49 CFR Part 193.2059, requires that "Each LNG container and LNG transfer system must have a [vapor] dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (incorporated by reference)". Section 2.2.3.4 of NFPA 59A (2001 edition) requires that provisions shall be made to minimize the possibility of a flammable mixture of vapors from a design [LNG] spill reaching a property line that can be built upon and that would result in a distinct hazard.

5.3.1 Design Spills – Single Accidental Leakage Source

NFPA 59A (2001 edition) Table 2.2.3.5 requires impounding areas serving only vaporization, process, or LNG transfer areas to contain a spill of LNG for 10 minutes from a single accidental leakage source. However, since a "single accidental leakage source" is not defined in either NFPA 59A (2001 edition) or 49 CFR 193, FERC and DOT PHMSA have developed a criteria to calculate design spill rates associated with such single accidental leakage sources. The resulting design spill rates are then used to calculate Exclusion Zones. The criteria to calculate design spill rates are provided on the DOT PHMSA LNG FAQ page¹.

Alaska LNG has prepared a Design Spill Package to submit to DOT PHMSA which describes the methodology used by the Project to calculate design spills. The Design Spill Package uses the same methodology to calculate design spills for LNG, refrigerant, and other hazardous fluids. This Design Spill Package includes a Piping and Equipment Inventory Database in accordance with guidance provided by DOT PHMSA. The Piping and Equipment Inventory Database is included in Appendix A of this report and evaluates 175 potential release scenarios.

5.3.2 DOT PHMSA Vapor Dispersion Written Interpretations

Until early 2009, the DEGADIS model was the standard used within the LNG industry to calculate vapor dispersion distances to demonstrate that the resulting "exclusion zones" remain within property controlled by the facility owners or areas controlled by a government entity. However, in an effort to develop LNG dispersion model evaluation tools for the NFPA 59A Committee, the Fire Protection Research Foundation (FPRF) funded research on LNG spill source term modeling and, in March, 2009 its findings were included in a report entitled "LNG Source Term Models for Hazard Analysis: A review of the State-of-the-Art and an Approach to Model Assessment". The report presented a methodology for assessing

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¹ http://www.phmsa.dot.gov/faqs/liquefied-natural-gas dated January 10, 2017.



the suitability of LNG source term models used in determining pool spread and vaporization and concluded that the source term model generally used within the industry to provide input to the DEGADIS dispersion model could result in under-prediction of hazard distances in some cases because it does not accurately represent vapor accumulation within impoundments, vapor flashing, and pool spreading.

Subsequently, in July, 2010, DOT PHMSA issued written interpretations² acknowledging the FPRF findings and described requirements that vapor dispersion exclusion zone analysis be performed for LNG facilities not yet in existence or under construction to demonstrate compliance with 49 CFR 193 and that the analysis should include vapor dispersion from:

- · Jetting and flashing,
- Conveyance of LNG to impoundments and
- LNG in impoundments.

Although the DEGADIS dispersion model was not a subject of concern for the FPRF, the model is not capable of solving the requirements to analyze the effects of jetting and flashing and the conveyance of LNG spills to impoundments. New models were required to perform this function and therefore, in its written interpretations, DOT PHMSA stated that applicants should provide an interpretation from PHMSA on the suitability of the specific source term model used to satisfy flammable vapor dispersion requirements.

5.3.3 Vapor Dispersion Modeling Tools

In 2010, Model Evaluation Protocols (MEP) and Model Evaluation Reports (MER) for two new vapor dispersion models were submitted to DOT PHMSA for review and approval. On October 7, 2011, DOT PHMSA issued final approvals allowing the models to be used (within certain conditions) to perform vapor dispersion analysis to demonstrate compliance with exclusion zones. The models currently approved for use to permit the construction of LNG facilities in accordance with 49 CFR Part 193 are the FLACS (v9.1) model (developed by GexCon) and the Phast (v6.6 or v6.7) model (developed by DNV).

CH-IV has used both the Phast and FLACS models to demonstrate compliance with 49 CFR 193.2059.

5.4 Analysis of Other Hazards Requirements

Although not an exclusion zone, Section 2.1.1.d of NFPA 59A (2001) states that "other factors applicable to the specific site that have a bearing on the safety of plant personnel and the surrounding public shall be considered. The review of

² PHMSA Interpretations #PI-10-0021 dated July 7, 2010 and #PI-10-0005, dated July 16, 2010.



such factors shall include an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility."

Therefore, asphyxiate vapor dispersion, toxic vapor dispersion, overpressure and jet fire analyses associated with releases of flammable/toxic materials will be performed for the Project. NFPA 59A and Part 193 do not provide recommended thresholds for analyzing these hazards; therefore, FERC has provided limits to determine the potential impacts on the public. The specific thresholds for analysis are discussed in the following sections.

6 WEATHER DATA ASSUMPTIONS

49 CFR 193.2057 provides that in calculating thermal radiation exclusion distances:

- The wind speed producing the maximum exclusion distances shall be used except for wind speeds that occur less than 5 percent of the time based on recorded data for the area.
- The ambient temperature and relative humidity that produce the maximum exclusion distances shall be used except for values that occur less than five percent of the time based on recorded data for the area.

The Meteorological Data Report (AKLNG-4030-HSE-RTA-DOC-00005) available in Appendix H.4 of Resource Report 13 details the analysis performed to develop the weather assumptions. The following table summarizes the weather conditions used for thermal radiation analysis:

Parameter	Value
Ambient Temperature (°F)	-7
Wind Speed (mph)	0-26
Relative Humidity (%)	33

Table 6-1: Thermal Radiation Weather Assumptions

49 CFR 193.2059 provides that "Dispersion conditions are a combination of those which result in longer predicted downwind dispersion distances than other weather conditions at the site at least 90 percent of the time, based on figures maintained by National Weather Service of the U.S. Department of Commerce, or as an alternative where the model used gives longer distances at lower wind speeds,

- Atmospheric Stability (Pasquill Class) F,
- Wind speed = 4.5 miles per hour (2.01 meters/sec) at reference height of 10 meters,
- Relative humidity = 50.0 percent, and
- ◆ Atmospheric temperature = average in the region."

The Meteorological Data Report (AKLNG-4030-HSE-RTA-DOC-00005) available in Appendix H.4 of Resource Report 13 details the analysis performed to develop the



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weather assumptions. The following table summarizes the weather conditions used for vapor dispersion analysis:

Table 6-2: Vapor Dispersion Weather Assumptions

Parameter	Value
Average Ambient Temperature (°F)	41.9
Wind Speed (m/s)	1 & 2 m/s
Relative Humidity (%)	50
Pasquill-Gifford Atmospheric Stability	F

7 THERMAL RADIATION EXCLUSION AND HAZARD ZONES

CH-IV used the LNGFIRE3 model with the weather assumptions detailed in Section 6 to calculate the thermal radiation exclusion zones for the impoundment sumps that have the potential to contain LNG. Sizing methodology for the Liquefaction Facility impoundment sumps is included in the Hydrocarbon Spill Containment Sizing Report, Document Number USAL-CB-FRZZZ-00-000005-000.

Table 7-1 summarizes the thermal radiation exclusion and hazard zones for the Liquefaction Facility's sumps and dikes.

Table 7-1: LNG Impounding Sump Thermal Exclusion Zones

		Distance (ft) t	Distance (ft) to:		
Source:		10,000 BTU/ft²-hr	3,000 BTU/ft²-hr	1,600 BTU/ft²-hr	
Liquefaction Train Impoundment Sumps		184	239	280	
LNG Storage Area Impoundment Sump		238	312	368	
LNG Storage Tanks		646	1,015	1,306	
BOG Compressor Area	Front View	63	79	91	
Impoundment Sump Side Vie		64	79	90	
LNG Loading Berths	Front View	59	79	118	
Impoundment Sumps	Side View	79	91	98	

Although not exclusion zones, thermal radiation modeling was performed on other impoundments to determine the hazards associated with pool fires from those impoundments. The results of the modeling show that all thermal radiation hazards associated with pool fires remain within the Liquefaction Facility property boundaries. Table 7-2 summarizes the thermal radiation distances.

Table 7-2: Other Impoundment Sumps and Dikes' Hazard Zones

		Distance (ft) to:		
Source:		10,000 BTU/ft²-hr	3,000 BTU/ft ² -hr	1,600 BTU/ft ² -hr
Condensate Truck Loading Impoundment Sump	Area	91	115	132
Liquefaction Compressor Im Sumps	poundment	61	76	86
Refrigerant Storage Area	Front View	129	166	193
Impoundment Sump	Side View	130	165	191
Condensate and Diesel	Front View	373	507	639
Storage Area Dike	Side View	375	486	568
Fractionation Area	Front View	63	79	91
Impoundment Sump	Side View	64	79	90

Figures 7-1 through 7-5 depict the thermal radiation exclusion and hazard zones on the Liquefaction Facility plot plan. Note that the red line is the Project's property line.

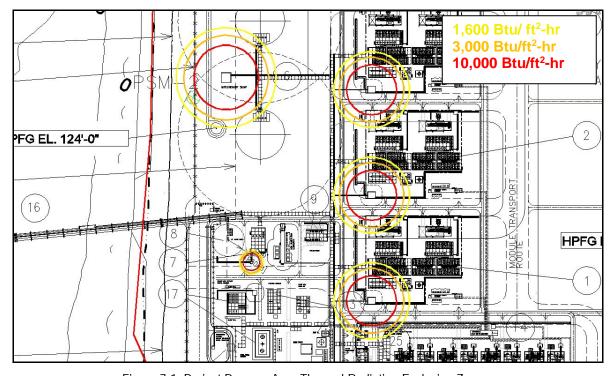


Figure 7-1: Project Process Area Thermal Radiation Exclusion Zones



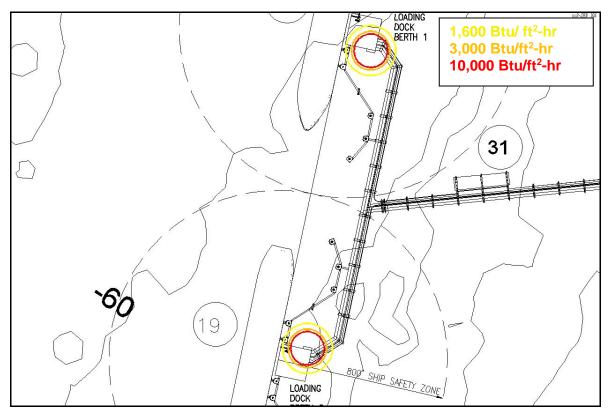


Figure 7-2: Project Dock Area Thermal Radiation Exclusion Zones



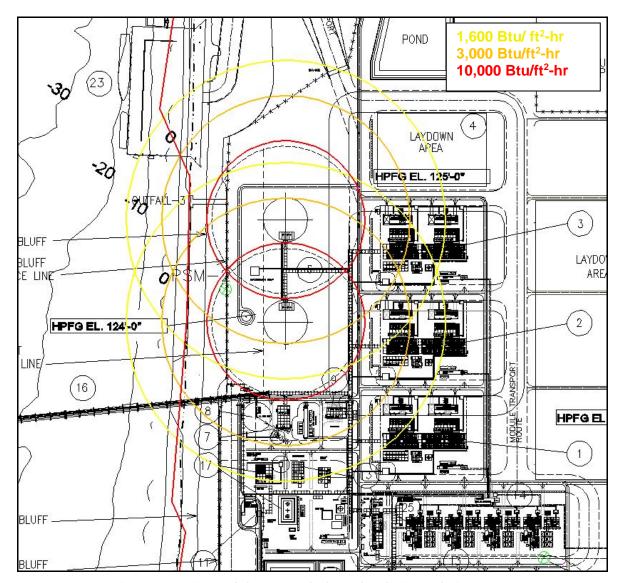


Figure 7-3: Project LNG Storage Tank Thermal Radiation Exclusion Zones



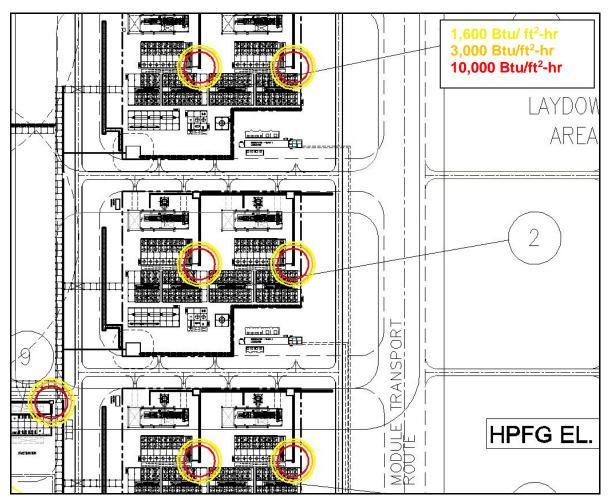


Figure 7-4: Project Process Area Thermal Radiation Hazard Zones



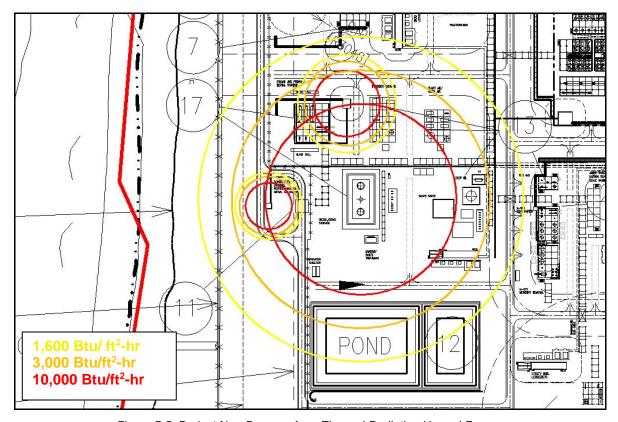


Figure 7-5: Project Non-Process Area Thermal Radiation Hazard Zones

As can be seen from Figures 7-1 thru 7-3, none of the thermal exclusion zones remain extend beyond the property lines of a property that can be built upon and will comply with the requirements of 49 CFR Part 193.

8 LNG VAPOR DISPERSION MODELING

In accordance with the August 6, 2013 letter from DOT PHMSA to FERC³, Alaska LNG will need concurrence on its selection of design spills and single accidental leakage sources from DOT PHMSA.

Therefore, Alaska LNG has prepared a Piping and Equipment Inventory Database in accordance with guidance provided by DOT PHMSA. The Piping and Equipment Inventory Database is included in Appendix A of this report and evaluates 11 potential LNG release scenarios.

³ August 6, 2013 Letter from Kenneth Lee, Director of Engineering and Research Division, Office of Pipeline Safety to Terry Turpin, LNG Engineering and Compliance Branch, Office of Energy Projects. Filed in Docket Number CP12-509 under Accession Number 20130813-4010.

8.1 LNG Composition

In accordance with recommendations made by DOT PHMSA in its Final Decisions regarding the use of the FLACS and Phast dispersion models (dated October 7, 2011) the properties of pure methane have been used in LNG vapor dispersion exclusion analysis to ensure conservative distances.

8.2 LNG Design Spills

The design spills associated with the potential single accidental leakage source of LNG transfer pipelines are detailed in the Piping and Equipment Inventory Database. Table 8.2 lists the single accidental leakage source scenarios that the Project expects will bound all LNG jetting and flashing scenarios vapor dispersion exclusion zones for leaks occurring at the Project.

Scenario #	Description	Line Size (inch)	Single Accidental Leakage Source (inch)
LNG-2A	Defrost Gas connection on the Hydraulic Turbine Outlet	4	4
LNG-3A	Quenching connection on the Loading Pump Outlet	4	4
LNG-3B	LNG Recirculation connection on the	4	4

Table 8.2 Single Accidental Leakage Source Determination

Operating conditions, such as pressure, temperature, flow rate and release elevation used in the analysis are presented in the Piping and Equipment Inventory Database included in Appendix A. All scenarios were modeled in the horizontal direction.

8.3 LNG Jetting and Flashing

In addition to location and flow rate considerations for determining the design spills to be analyzed for jetting and flashing, it is expected that the worst-case jetting and flashing scenarios (Bounding Scenarios) for the single accidental leakage sources detailed in Table 8.2 will result from a hole size that results in the greatest total vapor mass flow rate. When a pressurized leak occurs, the liquid jet will vaporize and, depending on the operating condition, a portion of the jet may rainout and pool on the ground. Since the greatest total vapor mass flow rate associated with a single accidental leakage source may not occur at the largest hole size, CH·IV used Phast to perform a sensitivity analysis (included in Appendix A) on multiple hole sizes to determine the discharge flow rate, release vapor mass flow rate (vaporized jet), rainout percentage, pool vapor mass flow rate, and total vapor mass flow rate.

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The resulting dispersion distance for each Bounding Scenario is shown in Table 8.3.

Scenario #	Bounding Scenario Hole Size (inch)	½ LFL Dispersion Distance (ft)
LNG-2A	4	2,477
LNG-3A	4	2,683
LNG-3B	4	2,779

Table 8.3 LNG Dispersion Distances

Each Bounding Scenario detailed above was modeled in Phast. The results of the modeling show that all LNG jetting and flashing releases maintain within Liquefaction Facility property and demonstrate compliance with 49 CFR 193.2059. The results are plotted on the Project plot plan in Figure 8.3. Note that the red line is the Project's property line.

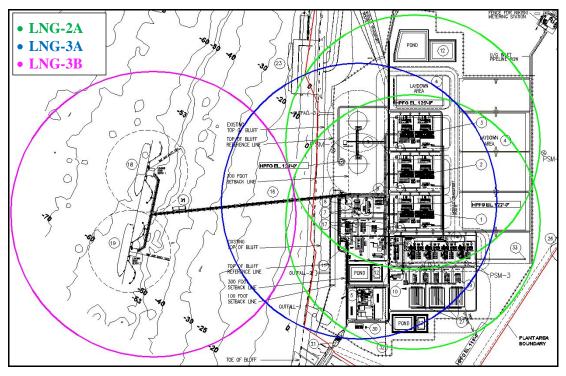


Figure 8.3 LNG Scenarios Distance to ½ LFL

8.4 LNG Conveyance

None of the LNG scenarios resulted in significant liquid rainout. However, the scenarios that had minimal liquid rainout were analyzed using the Phast modeling and accounted for the liquid rainout of the jetting and flashing scenarios when determining exclusion zones.



8.5 **LNG Storage Tank**

NFPA 59A (2001) Paragraph 2.2.3.5, as incorporated by reference in 49 CFR Part 193, requires a design spill for containers with over-the-top connections that involves "the largest flow from any single line that could be pumped into the impounding area with the container withdrawal pump(s) considered to be delivering the full rated capacity" for 10 minutes.

Each tank will operate with a maximum of four pumps in operation for ship loading with a total flowrate of 31,700 gpm. Conservatively, a 20% margin was provided to account total spill for pumps run-out case. Therefore, the total spill rate in the case of catastrophic rupture will be 38,040 gpm. As this maximum flow would occur at low pressure, this scenario has been modeled as a conveyance scenario using the FLACS software. The results are located in the GexCon Report in Appendix B.

9 REFRIGERANT AND HHC DISPERSION MODELING

Using the same methodology as was used to calculate LNG design spills, CH-IV has prepared a Piping and Equipment Inventory Database in accordance with guidance provided by DOT PHMSA to evaluate refrigerant spills. The Piping and Equipment Inventory Database is included in Appendix A of this report and evaluates potential MR, propane, ethane and HHC release scenarios.

9.1 **Refrigerant and HHC Composition**

Compositions of refrigerant spills scenarios are based on the compositions detailed in the Project Heat and Material Balances.

9.2 Refrigerant and HHC Design Spills

The design spills associated with the potential single accidental leakage source of refrigerants are detailed in the Piping and Equipment Inventory Database. Table 9.2 lists the single accidental leakage source scenarios that the Project expects will bound all refrigerant releases for leaks occurring in the Project.

Table 9.2 Single Accidental Leakage Source Determination

	9		J		
Scenario #	D	escription		Line Size (inch)	Sir Le

Scenario #	Description	Line Size (inch)	Single Accidental Leakage Source (inch)
MR-14A	Bypass on the HP MR Compressor Aftercooler Outlet	4	4
MR-18A	PSV connection on the MCHE Outlet	4	4
PR-4	Propane Storage Bullet to Storage Pump	6	2
PR-6A	Propane Subcooler Outlet to Reclaimer Condenser	4	4



Scenario #	Description	Line Size (inch)	Single Accidental Leakage Source (inch)
PR-8A	Defrost Gas connection on the MR/LP Propane Cooler	4	4
PR-31	Depropanizer Reflux Drum to Propane Reinjection Pumps	4	4
ETH-1A	Ethane Makeup from the Deethanizer Column	3	3
ETH-4	Deethanizer Reflux Drum to Deethanizer Reflux Pumps	8	2
HC-1	Scrub Column to Scrub Column Reboiler	8	2
HC-25	Debutanizer Reflux Liquid Return	4	4
HC-33	Condensate Loading Pump Outlet	3	3

Operating conditions, such as pressure, temperature, flow rate and release elevation used in the analysis are presented in Appendix A. Since the pipelines will be located aboveground, each scenario was modeled as a horizontal release. The propane and ethane storage tanks will be continuously charged up until their respective ESD valves downstream of the outlet tank nozzle. Therefore, CH-IV has modelled the scenario of a full deinventory on a single storage tank for both propane and ethane.

9.3 Refrigerant and HHC Dispersion

In addition to location and flow rate considerations for determining the design spills to be analyzed for refrigerant dispersion, it is expected that the worst-case scenarios (Bounding Scenarios) for the single accidental leakage sources detailed in Table 9.2 will result from a hole size that results in the greatest total vapor mass flow rate. When a pressurized leak occurs, the liquid jet will vaporize and, depending on the operating condition, a portion of the jet may rainout and pool on the ground. Since the greatest total vapor mass flow rate associated with a single accidental leakage source may not occur at the largest hole size, CH·IV used Phast to perform a sensitivity analysis (included in Appendix A) on multiple hole sizes to determine the discharge flow rate, release vapor mass flow rate (vaporized jet), rainout percentage, pool vapor mass flow rate, and total vapor mass flow rate.

The resulting dispersion distance for each Bounding Scenario is shown in Table 9.3.

Table 9.3 Refrigerant and HHC Dispersion Distances

Scenario #	Bounding Scenario Hole Size (inch)	½ LFL Dispersion Distance (ft)
MR-14A	4	732



Scenario #	Bounding Scenario Hole Size (inch)	½ LFL Dispersion Distance (ft)
MR-18A	4	1,704
PR-4	2	608
PR-6A	4	1,157
PR-8A	4	1,700
PR-31	4	1,023
ETH-1A	3	179
ETH-4	2	237
HC-1	2	799
HC-25	4	1,174
HC-33	3	383

All refrigerant and HHC dispersion scenarios would remain outside of public areas containing schools, hospitals or other sensitive areas. All of the scenarios were modeled in Phast and are illustrated in Figures 9.3-1 thru 9.3-4. Note that the red line is the Project's property line.

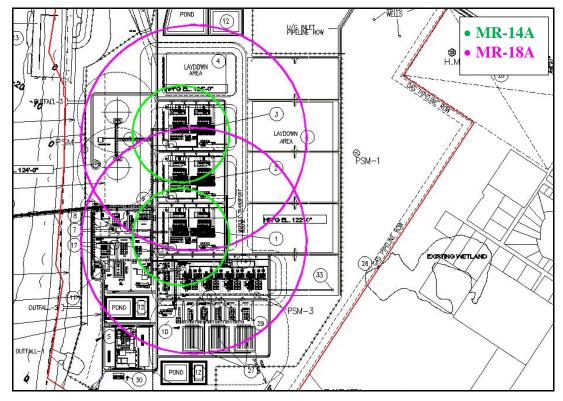


Figure 9.3-1 MR Scenarios Distance to ½ LFL



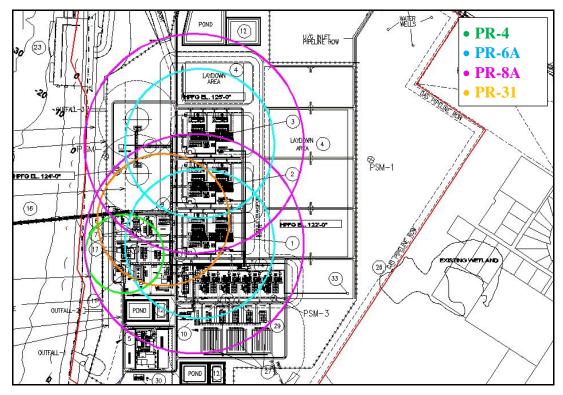


Figure 9.3-2 Propane Scenarios Distance to ½ LFL

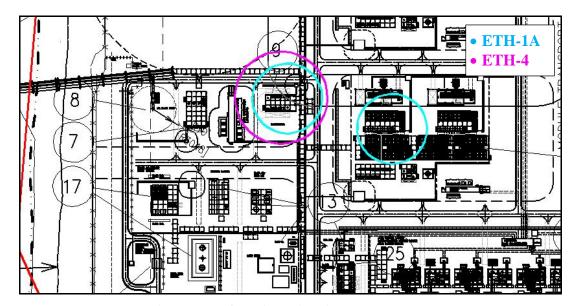


Figure 9.3-3 Ethane Scenarios Distance to ½ LFL



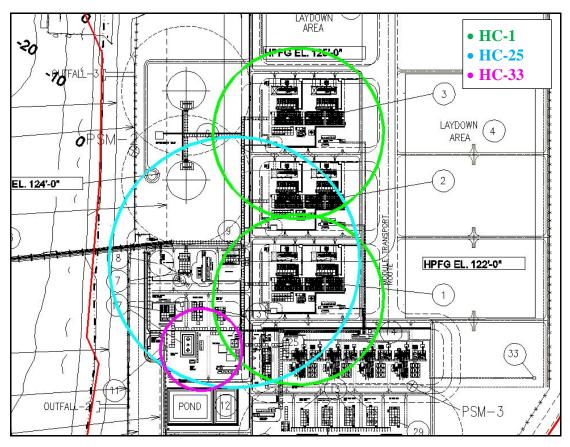


Figure 9.3-4 HHC Scenarios Distance to ½ LFL

9.4 Overpressure Modeling

The Project has also analyzed the hazards associated with Refrigerant and HHC dispersion scenarios that could result in an overpressure.

Ethane, propane and butane+ have higher reactivity than methane and pose a greater risk for generating overpressure or vapor cloud explosion.

Overpressures are calculated based on the design spills as listed in Section 9.3. The Baker-Strehlow-Tang (BST) Explosion Model was used in Phast (v6.7) to estimate the distances to the 1 psig threshold resulting from a refrigerant (primarily propane) release. Within the Phast calculations, the flammable vapor cloud is ignited at the greatest LFL cloud extent and conservative assumptions were used to define obstacle density and flame expansion.

Table 9.4 lists the overpressure scenarios and the resulting distance to 1 psig.



Table 9.4 Refrigerant and HHC Release Overpressure Distances

Scenario #	Bounding Scenario Hole Size (inch)	Distance to 1 psig Overpressure Threshold (feet)
MR-14A	4	1,913
MR-18A	4	820
PR-4	2	767
PR-6A	4	1,509
PR-8A	4	1,311
PR-31	4	1,424
ETH-1A	3	204
ETH-4	2	281
HC-1	2	963
HC-25	4	2,313
HC-33	3	842

The results of the Phast modeling are illustrated in Figure 9.4-1 thru 9.4-4. Note the red line is the Project's property line. The results of the overpressure analysis illustrate that a 1 psig threshold would not extend over a property line that could be built upon and would therefore remain outside if public area containing schools, hospitals or other sensitive areas.



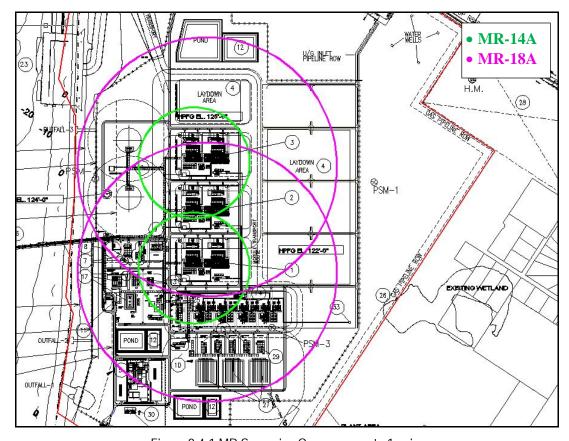


Figure 9.4-1 MR Scenarios Overpressure to 1 psig

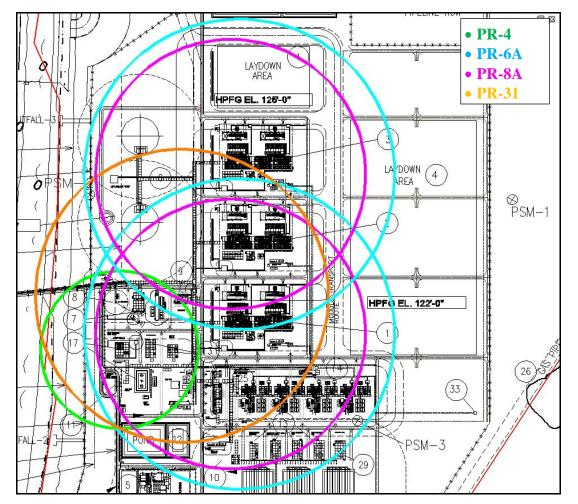


Figure 9.4-2 Propane Scenarios Overpressure to 1 psig



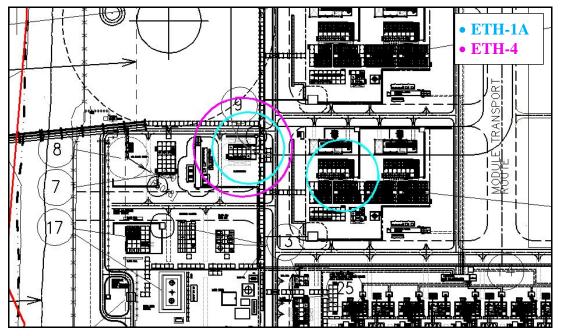


Figure 9.4-3 Ethane Scenarios Overpressure to 1 psig

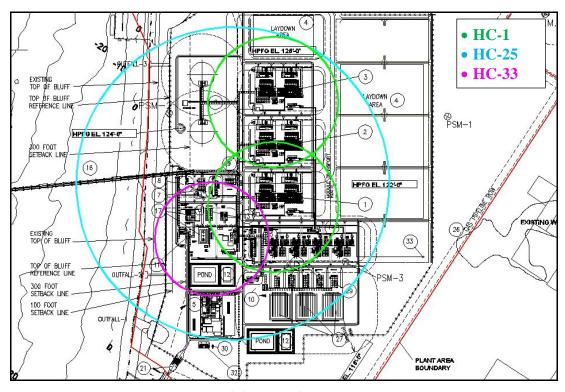


Figure 9.4-4 HHC Scenarios Overpressure to 1 psig



10 LIQUID NITROGEN ANALYSIS

10.1 Nitrogen Design Spills

The main potential hazards associated with liquid nitrogen are asphyxiation and cryogenic temperatures. Simple asphyxiates are inert gases or vapors that displace oxygen from air when present in high concentrations. In low concentrations, they have no physiologic effects. By volume, dry air contains approximately 78% nitrogen, 21% oxygen, and under 1% other gasses. When the oxygen concentration is below 16%, people have decreased mental alertness, visual acuity and muscular coordination. Loss of consciousness occurs at concentrations below 10% and death occurs at oxygen concentrations below 6%.

Liquid nitrogen would be present in storage tanks and outlet piping which would connect to vaporizers which would turn the liquid nitrogen into vapor before sending to the plant for use. Therefore, a liquid nitrogen release could only originate from a failure of the liquid nitrogen storage tank or a failure of the vaporizer feed piping. The total liquid nitrogen storage will be 21,371 ft³.

Due to the undefined design for the liquid nitrogen storage area, three failure scenarios were analyzed using the Phast model:

- 2 inch full guillotine failure of the liquid nitrogen transfer piping
- 3 inch full guillotine failure of the liquid nitrogen transfer piping
- 4 inch full guillotine failure of the liquid nitrogen transfer piping

FERC has requested that each scenario be analyzed to trace the concentration of nitrogen to 80.5%, 84% and 87.5% which would correspond to an oxygen concentration of approximately 19.5%, 16% and 12.5%, respectively. The results of the modeling is shown in the following table:

Failure Scenario:	Distance to 19.5% Oxygen Concentration (feet):	Distance to 16% Oxygen Concentration (feet):	Distance to 12.5% Oxygen Concentration (feet):
2 inch failure of piping	Not Reached	Not Reached	Not Reached
3 inch failure of piping	Not Reached	Not Reached	Not Reached
4 inch failure of piping	Not Reached	Not Reached	Not Reached

Table 10.1: Liquid Nitrogen Scenarios

Since there is no liquid rainout from any of the modeled scenarios, secondary containment is not necessary. The nitrogen storage equipment is also located in a remote area away from the liquefaction and control room or administration areas.



11 TOXICITY MODELING

Although not exclusion zones, the Project has also analyzed the hazards associated with toxic vapor cloud dispersion.

In order to comply with Section 2.1.1(d) of NFPA 59A (2001 edition), as discussed in Section 4 of this report, the Project has considered exposures associated with a release of a toxic vapor cloud. Based on a review of the facility Process and Instrumentation Drawings (P&IDs), Heat and Material Balances (H&MBs), and Process Flow Diagrams (PFDs), the following toxic components have been identified:

- ◆ Acid Gas (hydrogen sulfide), and
- Condensates (benzene, hexane, propane, butane and mercaptans)

11.1 Acute Exposure Guideline Level

FERC has requested applicants perform toxicity modeling in accordance with the Acute Exposure Guideline Levels (AEGL) maintained by the U.S. Environmental Protection Agency.

With respect to hazards to the general public, the National Advisory Committee for the Development of Acute Exposure Guideline Levels developed levels for hazardous substances and defines the three AEGL levels as:

- AEGL 1: The airborne concentration of a substance above which it is predicted
 that the general population, including susceptible individuals, could experience
 notable discomfort, irritation, or certain asymptomatic nonsensory effects.
 However, the effects are not disabling and are transient and reversible upon
 cessation of exposure.
- AEGL 2: The airborne concentration of a substance above which it is predicted
 that the general population, including susceptible individuals, could experience
 irreversible or other serious, long lasting adverse health effects or an impaired
 ability to escape.
- AEGL 3: airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience lifethreatening health effects or death.

The concentrations associated with the three AEGL levels are dependent on the time a person could ingest, inhale, or be exposed to a toxic substance and are listed as 10 minute, 30 minute, 60 minute, 4 hour, and 8 hour exposure durations.

AEGLs are developed carefully and systematically from the available scientific data and are thoroughly peer reviewed and published in the Federal Register. AEGLs represent the best scientific judgment about the airborne concentrations of a chemical that correspond to the standard definitions of the three AEGL levels.

Unlike flammability limits which have a specific, definitive concentration that presents a hazard, the AEGL levels represent a range of responses based on case reports, human studies, experimental studies on lethality and irritation in animals,



and other available information. AEGLs represent the concentrations at which most people, including sensitive individuals such as old, sick, or very young people, will begin to experience health effects if they are exposed to a hazardous chemical. While a flammable refrigerant will always ignite when an ignition source is present within its flammability limit, different individuals will feel different symptoms at varying concentrations as described in the Technical Support Documentation for each substance.

Other industries which calculate AEGL levels in accordance with the levels maintained by the U.S. EPA do not include additional safety factors on top of the AEGL levels. FERC has requested that applicants include a safety factor of 2 to account for uncertainty in the models.

Therefore, the Project has evaluated the consequences of a potential release of NGLs, process condensate and acid gas using the current ½ AEGL thresholds.

11.2 Emergency Response Planning Guidelines

DOT PHMSA has requested applicants perform toxicity modeling in accordance with the Emergency Response Planning Guidelines (ERPG) and to use the ERPG-2 endpoint as specified in the EPA's Risk Management Program regulations detailed in 40 CFR 68.

ERPG's estimate the concentrations at which most people will begin to experience health effects if they are exposed to a substance for 1 hour. The EPA defines the three ERPG levels as:

- ERPG 1: The maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.
- ERPG 2: The maximum airborne concentration below which nearly all
 individuals could be exposed for up to 1 hour without experiencing or developing
 irreversible or other serious health effects or symptoms which could impair an
 individual's ability to take protective action.
- ERPG 3: The maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

Similar to AEGLs, ERPG's represent a range of responses based on case reports, human studies, experimental studies on lethality and irritation in animals, and other available information.

11.3 Design Spills

Design spills for toxicity modeling are based on the same methodology currently used to determine single accidental leakage sources for LNG releases. In the case of toxics, the cases are determined based on greatest amount of toxic material in



flow streams. Design spills for toxic components are included in the Piping and Equipment Inventory Database, which can be found in Appendix A of this report.

Table 11.3 Toxics Single Accidental Leakage Source

Line Description Size #

Single Accidental Scenario Leakage Source (inch) (inch) HC-1 Scrub Column to Scrub Column Reboiler HC-16 2 Debutanizer Reboiler Inlet 8 HC-32 2 6 Condensate Storage to Loading Pumps

Operating conditions, such as temperature, pressure, flow rate and release elevation used in the analysis are presented in Appendix A. Since the pipes will be located aboveground in an open piperack, each scenario was modeled as a horizontal release.

When a pressurized leak occurs, the liquid jet will vaporize and, depending on the operating condition, a portion of the jet may rainout and pool on the ground. Since the greatest total vapor mass flow rate associated with a single accidental leakage source may not occur at the largest hole size, CH·IV used Phast to perform a sensitivity analysis on multiple hole sizes. The results of the sensitivity study are presenting in the Phast Spreadsheet included in Appendix A.

11.4 **Combined Toxic Analysis**

The HHC releases have been modeled with an approach to consider additive toxicity of all toxic components within the mixture such as hexanes, butanes, propane, hydrogen sulfide and mercaptans.

The CGA P-20 Standard for Classification of Toxic Gas Mixtures (2009 edition), provides a method for calculating the summation of more than one toxic component within a mixture. This calculation was used for providing modeling results on the condensate release scenarios. Separately, benzene is tracked as an individual component for the ERPG distance.

The Phast (v6.7) software was used to calculate the ½ AEGL and ERPG levels for each mixture to determine the worst case toxic distances for a release. The AEGL levels were chosen based on the maximum exposure time for scenarios involving rainout. For scenarios that resulted in rainout, an exposure time of 30 minutes was used, and for scenarios that didn't result in rainout, an exposure time of 10-minutes was used. The averaging time was set to the toxic exposure time. Since the pipes will be located aboveground, each release was modeled as a horizontal release.

The Phast model results for tracking toxics in the HHC streams are presented in Table found below:



Table 11 4	Combined 1/2 AFGL	and FRPG- 2 Distances
10000 11.4	· COHUNICO // ALCI	and file at a distances

Scenario #	Toxicity Level	Distance (ft)
	1/2 AEGL-1	1,541
HC-1	1/2 AEGL-2	662
ПО-1	½ AEGL-3	246
	Benzene ERPG-2	283
	1/2 AEGL-1	2,908
HC-16	1/2 AEGL-2	2,262
NC-10	½ AEGL-3	613
	Benzene ERPG-2	1,179
	1/2 AEGL-1	1,049
HC-32	1/2 AEGL-2	676
110-32	½ AEGL-3	440
	Benzene ERPG-2	569

The results of the Phast modeling are illustrated in Figure 11.4-1 and 11.4-2. All toxic vapor clouds will remain within the Liquefaction Facility property lines and not extend over any homes, hospitals or parks.

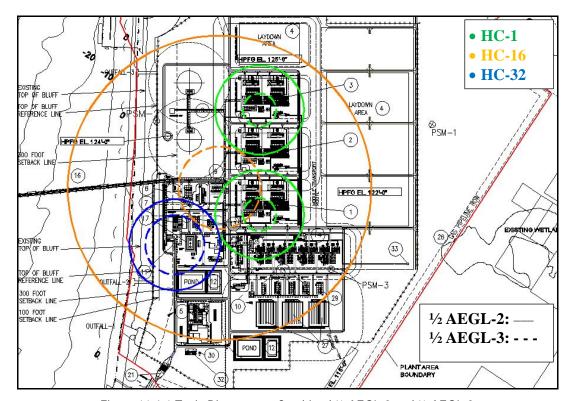


Figure 11.4-1 Toxic Distances to Combined ½ AEGL-2 and ½ AEGL-3



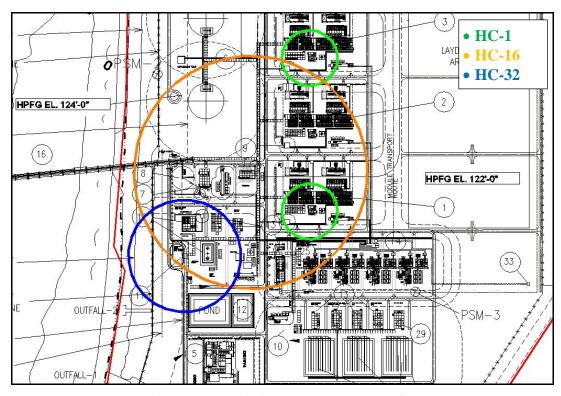


Figure 11.4-2 Toxic Distances to Benzene ERPG-2

12 JET FIRE ANALYSIS

The Phast model was used to calculate the jet fire thermal radiation distances for all spill scenarios, as shown in Tables 8.3 and 9.3. Table 12 summarizes the distances to 10,000 Btu/ft²-hr, 3,000 Btu/ft²-hr and 1,600 Btu/ft²-hr for the flammable release scenarios:

Table 12 Jet Fire Thermal Distances

Scenario #	Bounding Hole Size (in)	1,600 Btu/ft ² -hr Distance: (feet)	3,000 Btu/ ft ² -hr Distance: (feet)	10,000 Btu/ ft ² -hr Distance: (feet)
LNG-2A	4	888	783	663
LNG-3A	4	866	774	643
LNG-3B	4	865	775	643
MR-14A	4	556	464	326
MR-18A	4	1,088	955	767
PR-4	2	401	355	292
PR-6A	4	840	742	606
PR-8A	4	550	485	391



Scenario #	Bounding Hole Size (in)	1,600 Btu/ft²-hr Distance: (feet)	3,000 Btu/ ft²-hr Distance: (feet)	10,000 Btu/ ft²-hr Distance: (feet)
PR-31	4	806	712	582
ETH-1A	3	181	156	114
ETH-4	2	213	183	132
HC-1	2	526	458	364
HC-25	4	375	330	263
HC-33	3	104	92	75

The plant layout illustrating the bounding 1,600 Btu/ft²-hr jet fire thermal distances for LNG, MR, Propane, Ethane and HHC releases are located in Figures 12-1, 12-2, 12-3, 12-4 and 12-5, respectively. Note that the red line represents the Project's property line. All of the 1,600 Btu/ft²-hr isopleths would remain outside of public areas containing schools, hospitals or other sensitive areas.

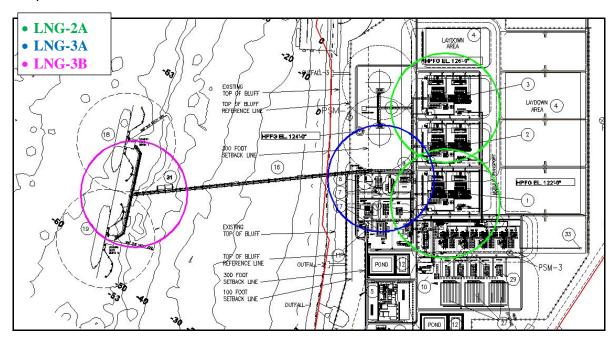


Figure 12-1 LNG Scenarios Distance to 1,600 Btu/ft2-hr Jet Fire

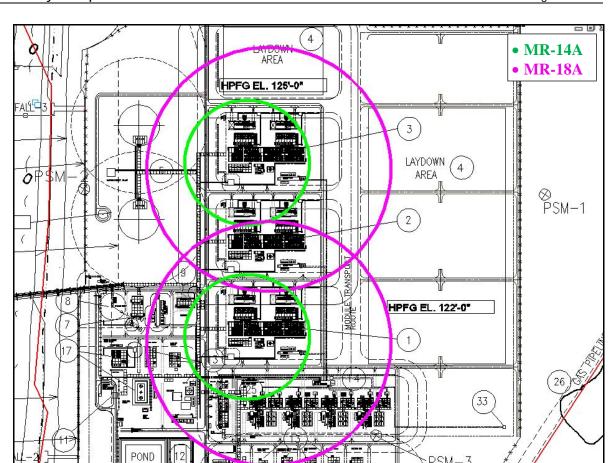


Figure 12-2 MR Scenarios Distance to 1,600 Btu/ft²-hr Jet Fire

PSM-3



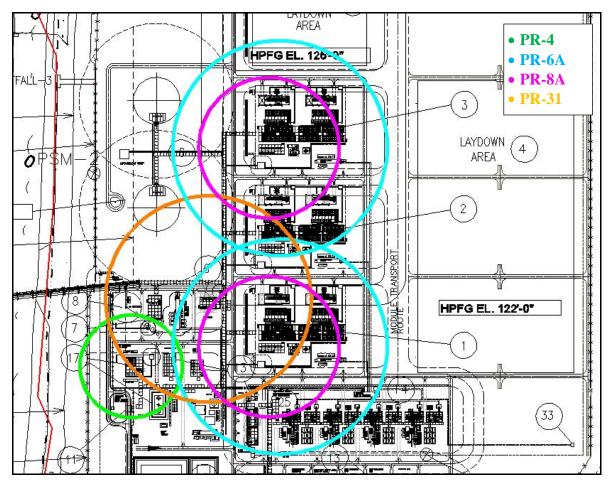


Figure 12-3 Propane Scenarios Distance to 1,600 Btu/ft²-hr Jet Fire

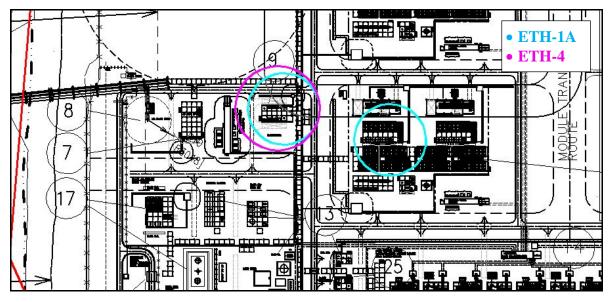


Figure 12-4 Ethane Scenarios Distance to 1,600 Btu/ft²-hr Jet Fire



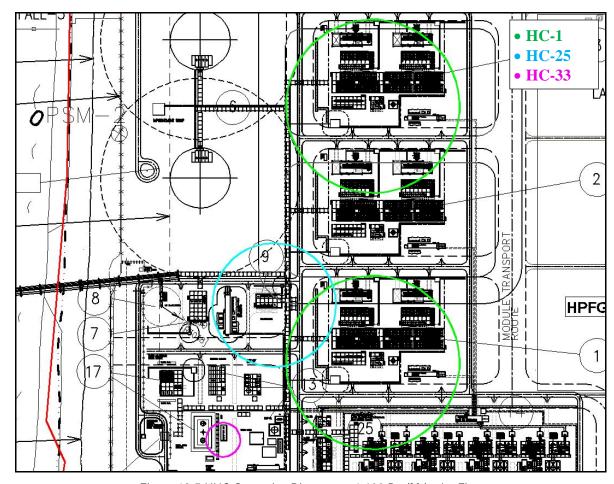


Figure 12-5 HHC Scenarios Distance to 1,600 Btu/ft²-hr Jet Fire

Unlike an LNG pool fire, a jet fire will only be present when there is sufficient pressure and inventory in the system to sustain the jet fire. While a large liquid pool fire will continue to burn until all LNG is consumed, a jet fire will lose its duration and associated thermal radiation flux distance when ESD valves are actuated and the pressure in the system decreases. To prevent cascading failures and BLEVEs, numerous mitigation measures are in place in the current design.

- The design provides compliance with applicable codes for equipment selection and system design. Examples include use of well-proven equipment and materials, implementation of methods for minimizing flanges and potential leakage sources, and installation of appropriate control and safety systems
- The facilities shall be arranged in accordance with the requirements of 40 CFR 68, 49 CFR 193 and NFPA 59A. The refrigerant storage vessels will be fireproofed or fitted with a fixed water spray system to prevent exposure effects from potential nearby fires.
- ◆ The Project has been designed such that areas likely to contain flammable gas mixtures will be isolated from ignition sources in accordance with NFPA 70 (2001)



and the National Electric Code. Electrical equipment used within these designated areas will be housed in enclosures approved for this service and application.

- ◆ The design will include the installation of hazard detection equipment which may alarm and/or shutdown process equipment as detailed in Resource Report 13.
- ◆ The design of the Emergency Shut Down (ESD) system to isolate inventory, decrease pressure, and limit a jet fire duration. Details of the ESD valves are shown on the P&IDs and included in the Cause and Effect Matrices included in Resource Report 13.
- The design will include the installation of firewater monitors, hose sprays, and nozzles with sufficient water capacity and pressure to deluge adjacent process equipment and piping where impingement of jet fires could cause a cascading failure. Details of the firewater coverage areas are included in Resource Report 13. Passive fire protection will also be applied in accordance with the principles defined in API 2218.
- ◆ The design will include the installation of both fixed, wheeled, and portable dry chemical systems. Details of the location of the dry chemical extinguishers are included in Resource Report 13.
- ◆ The project structures facility operations to prevent failures and mitigate consequences through the use of appropriate procedures, inspections, maintenance, training, and supervision. Examples include the operations and maintenance manual, emergency response plan/manual, and frequent training sessions. A preliminary Emergency Response Plan is included in Resource Report 11.

The inclusion of the above independent mitigation measures will conservatively mitigate the potential for jet fires to cause cascading effects to adjacent equipment and piping and will mitigate the potential for BLEVEs.

13 CONCLUSION

The purpose of this Report is to provide modeling assumptions and the results of the Hazard Analysis for the Project. The Report:

- Describes the design spill assumptions and methodology used in the siting analysis performed for the proposed Project to calculate exclusion zones required per Part 193.2057 and Part 193.2059.
- Demonstrates that the analysis performed is consistent with current guidance between FERC and DOT PHMSA to provide a quantitative basis for determining single accidental leakage source and calculating design spills, and
- Demonstrates that the Project complies with the requirements of 49 CFR 193.2057 and 193.2059 and that the resulting exclusion or hazard zones encompass areas that remain within the land to be controlled by Alaska LNG or would not extend over a property line that could be built upon.

The Piping and Equipment Inventory Database is prepared and formatted to include all information requested by DOT PHMSA. The bounding scenarios determined in the database have been analyzed with the unified dispersion analysis software, PHAST (v6.7)





or the computation fluid dynamics software, FLACS (v9.1), to determine their vapor dispersion and overpressure distances, where applicable. The following summarizes the hazard analysis performed for the Alaska LNG Project:

- The impoundment basins analyzed for thermal radiation analysis associated with containment of flammable hydrocarbons remain within the land to be controlled by Alaska LNG.
- ◆ The ½ LFL vapor dispersion cloud from the 3 bounding LNG releases remain within the land to be controlled by Alaska LNG or would not extend over a property line that could be built upon.
- ◆ The ½ LFL vapor dispersion cloud from the 11 bounding flammable fluid releases remain outside of public areas containing schools, hospitals or other sensitive areas.
- ◆ The overpressure calculations for the 11 refrigerant and HHC fluid releases remain within the land to be controlled by Alaska LNG and remain outside of public areas containing schools, hospitals or other sensitive areas.
- Nitrogen releases remain within the land to be controlled by Alaska LNG and pose no hazards to the public. Operators will be trained in property handling and behavior of cryogenic materials processed on-site
- The 3 scenarios analyzed for dispersion of toxic materials will not result in impact public areas containing schools, hospitals or other sensitive areas.
- The 14 bounding scenario cases analyzed for thermal radiation analysis associated with jet fires remain within the land to be controlled by Alaska LNG. Escalation from jet fires will be mitigated by the depressurization and emergency shutdown system as well as significant passive features included in the site layout. Descriptions of the two systems are provided throughout the Project design documents.



APPENDIX A: PIPING AND EQUIPMENT INVENTORY DATABASE

Piping and Equipment Inventory Database is Privileged & Confidential and will be provided to FERC Staff electronically.





APPENDIX B: GEXCON REPORT



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RR13 APPENDIX TABLE OF CONTENTS	14 April 2017
	REVISION: 1
PUBLIC	APPENDIX COVERSHEET

H.4 – Meteorological Data

Document Number:	Description:	Revision:	Appendix:
AKLNG-4030-HSE-RTA-DOC-00005	Meteorological Data Report	0	Public

Alaska LNG



METEOROLOGICAL DATA REPORT (LIQUEFACTION FACILITY)

AKLNG-4010-HSE-RTA-DOC-00005



Alaska LNG

Meteorological Data (Liquefaction Facility)



Rev No.	Issue Purpose:	Date:	Ву	CHK	APP
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0	Issued for Information	April 5, 2017	HES	JMW	PJS



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1 **WEATHER DATA**

A meteorological data analysis has been performed to determine the weather conditions to be used to calculate thermal radiation and vapor dispersion exclusion zones for the Alaska LNG Project. Federal code 49 C.F.R. Part 193 requires weather data to be "based on figures maintained by National Weather Service of the U.S. Department of Commerce". The National Weather Service is a component of the National Oceanic and Atmospheric Administration (NOAA) and is an operating unit of the U.S. Department of Commerce.

The proposed Facility is to be located in Nikiski, AK. The weather data used in the analysis were from two sources: (1) the Kenai Municipal Airport Station, which is approximately 8.5 miles from the proposed Facility site and (2) the NOAA Data Buoy NKTA2, which is approximately 1 mile away from the proposed Facility site. For vapor dispersion, an average temperature and wind speed were taken from the NOAA Data Buoy as they were representative of the conditions to be experienced at site and provided hourly data. For thermal radiation, the Kenai Airport Station data was used to obtain a daily low temperature, high wind speed, and daily low relative humidity as the NOAA Data Buoy did not provide relative humidity data. The temperature, wind speed and humidity values are from data reported 2007-2016.

1.1 **Thermal Radiation Weather**

49 C.F.R. § 193.2057 provides that in calculating thermal radiation exclusion distances:

- The wind speed producing the maximum exclusion distances shall be used except for wind speeds that occur less than five percent of the time based on recorded data for the area.
- The ambient temperature and relative humidity that produce the maximum exclusion distances shall be used except for values that occur less than five percent of the time based on recorded data for the area.

Therefore, CH·IV has analyzed local weather data and selected the following criteria for the thermal radiation analysis:

Table 1.1: Thermal Radiation Weather Assumptions

Parameter	Value
Ambient Temperature	-7 °F
Wind Speed	Varies from 0-26 mph
Relative Humidity	33%

The detailed weather data, which was used to demonstrate compliance with the requirements of 49 C.F.R. § 193.2057, will be supplied directly to the FERC in spreadsheet format due to its large file size.



1.2 Vapor Dispersion Weather

49 C.F.R. § 193.2059 provides that "Dispersion conditions are a combination of those which result in longer predicted downwind dispersion distances than other weather conditions at the site at least 90 percent of the time, based on figures maintained by National Weather Service of the U.S. Department of Commerce, or as an alternative where the model used gives longer distances at lower wind speeds,

- Atmospheric Stability (Pasquill Class) = F,
- Wind speed = 4.5 miles per hour (2.01 meters/sec) at reference height of 10 meters,
- Relative humidity = 50.0 percent and
- Atmospheric temperature = average in the region."

Therefore, CH·IV has analyzed local weather data and selected the following criteria for the vapor dispersion analysis:

Table 1.2: Vapor Dispersion Weather Assumptions

Parameter	Value
Average Ambient Temperature	41.9 °F
Wind Speed	1.3, 1.5 and 2 m/s
Relative Humidity	50%
Pasquill-Gifford Atmospheric Stability	F

The detailed weather data, which was used to demonstrate compliance with the requirements of 49 C.F.R. § 193.2059, will be supplied directly to the FERC in spreadsheet format due to its large file size