Princess Cruise Ship
Shore Power Project – 2001
Juneau, Alaska

Corry V. Hildenbrand
Project Manager
V. P. Energy Resource Development
Alaska Electric Light & Power Co.
Princess Cruises Shore Power Facility Juneau, Alaska
Shore Power Details

- Substation
- Steam Boiler
- Transformer
- Electrical Cables
- Festooning System
- Operations
- Questions
Substation Civil Work
Substation Construction
Setting Transformer
Excavation of cable Trench
Boring Under Road
HV Cable Pull Vault
Conduit Installation
Substation 6.6 & 11 KV Breakers
Power Transformer & Circuit Switcher
Transformer Commissioning

- Oil Filtration
- Meggar
- Power factor
- TTR Testing
7 MW Electric Boiler
Electrical Boiler Building
Transformer Design Criteria

High Voltage: W1 Primary

- Rated Power
  - 25 MVA at 2nd forced air cooling stage
- Rated Primary Voltage
  - 67,000 V Delta 350KV BIL
- Taps
  - plus/minus 5% range from nominal
  - 2.5% incremental steps
- 55 degree C rise / 65 degree rise with forced air cooling
- 30 C average/ 40 C maximum ambient as per ANSI standard
- 7% impedance with plus/minus ANSI standard
- Copper Conductor
- Oil filled with Type I oil as per ANSI standard
- 65 DB(A) Guaranteed Sound Level
- 100 Feet Maximum Altitude
Transformer Design Criteria

Low Voltage Side: W2 Secondary (Electric Boiler & Winter
AELP Distribution Feeder)
- Rated Power
  - 8.75 MVA at 2\textsuperscript{nd} forced air (FA) cooling stage
  - 12 MVA at 2\textsuperscript{nd} FA cooling stage when W3 is not loaded
- Rated Voltage
  - 12.47 KV Wye connected with neutral bushing
- Copper conductor

Low Voltage Side: W3 Secondary (Ship Hotel Load)
- Rated Power
  - 16.25 MVA at 2\textsuperscript{nd} FA cooling stage
- Rated Voltage
  - 11 KV with a full power rated 6.6 KV Tap; Wye connected with a neutral grounding resistor
Transformer Design Criteria

Included In The Transformer Package

- H.V. metering pre-wired on the transformer
- Potential Transformers mounted on the transformer
- Current Transformers
- Relaying package pre-wired on the transformer
Protection

- GE-745 Transformer Management Relay
- S&C series 2010 circuit switcher
- ABB Type R Vacuum Circuit Breakers (2000A, 1200A)
- ABB DPU-2000 Relays
- Cooper Type VWE Reclosure and Form5 Controller
- AFL oil stop valve & oil containment system
- ALCAD 125VDC Control Power System
Power Cable

Substation to Dock Disconnect

- Okonite 15kV EPR Cable
  - 750 MCM
  - (3) parallel runs per phase
- A Copper Conductor
- B Semiconducting
- C Insulation
- D Insulation
- E Shield-Copper Tape
- F Jacket

www.okonite.com
Mining HV Cable For Ship Power Connection

- Grounding Conductor
- AMERICABLE (mining cable)
- 15kv 250 MCM Cu Conductor
- EPR Insulation
- CPE Jacket

AEL&P
Conduit Installation on Dock
Conduit Installation on Dock
Dock Disconnect/Grounding Switch Cabinet
HV Terminations @ Disconnect/Grounding Switch
Gantry
Festoanning
Cable
Location
System
Festooning System Allows for Cable Adjustment for Tidal Fluctuations
Gantry Cable Festooning System
Lowering Shore Power Cables
Connecting Shore Cables
Each Cruise Ship has Bulkhead Doors to Accommodate the Shore Power Cables and the LP Steam Lines.
Shipboard Cables Connections

- 4 Power Connectors (Callenberg)
- 1 Neutral Connection (Callenberg)
- 2 Control (Cannon Plug)
- 1 SCADA (Cannon Plug)
- Standardization of Cable Connections
Shipboard Automation

- Shipboard Automatic Synchronization
- Real and Reactive Load Transfer Rates
- Less Than 500 KW and 500 KVAR Separation
- Ship to Shore Isolation (Fault or other Protective Parameters)
- No Shipboard Manual Controls
- Standardization of Shipboard Programming
SCADA
Supervisory Control and Data Acquisition

AEL&P
Ship to Shore SCADA & Control Interface

• RS-485 4-wire communication link
• Modbus is used for the SCADA Communication Protocol
• Modbus Register Addressing
• Ship to Shore Permissives and Protection are hard wired
• Ship to Shore Standardization
Power Dispatcher’s Role

- Communications with Ship on Connection and Disconnection Time
- Coordination of Switching Orders
- Dispatch of Lineman for Connection and Disconnection of Ship
- SCADA Control of Energization of Shore Circuit to Ship
- Coordination of Loading of Shore LP Electric Steam Boiler
Design and Construction Responsibility

- AELP – Substation to Dock Located Disconnect/Grounding Switch, SCADA & Control Interface to Ships
- Callenberg – Ship Board Switchgear and Interface to AELP’s Shore Power
- PN&D – Modifications of Dock for Cable Gantry Festooning System
- ABB & Siemens – Shipboard Automation
Design & Construction Timing

- Notice to Proceed Give by Princess December 1, 2000
- On Line Early June 2001
In Summary

Electrical Energy Sales In Juneau, Alaska to Princess

- Ship Hotel Electrical Loads 7 to 11 MW @ 6.6 KV or 11 KV and .83 to .86 PF
- Ship LP Steam Loads 4 to 6 MW @ 12.47 KV and Unity PF
- Total Annual Demand for Shore Power is 11 - 12 GWH Annually
First High Voltage Shore Power Connection for Cruise Ships

Juneau, Alaska