

CRUISE SHIP SHORE POWER PROJECTS

Alternative Maritime Power (AMP) Conference
Los Angeles Harbor Hotel, San Pedro, CA
April 24-25, 2006



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EVP of Shore Operations,
Princess Cruises &
CEO, Princess Tours



Mike Watts
Manager
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Cochran, Inc.



Per Thunem
VP of Systems &
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Callenberg Engineering Inc.

CRUISE SHIP SHORE POWER PROJECTS

CRITERIA FOR A SUCCESSFUL SHORE POWER PROJECT

Dean C. Brown

**EVP of Shore Operations, Princess Cruises &
CEO, Princess Tours**

Criteria for a Successful Shore Power Project

- Availability of an adequate supply of electricity at a reasonable cost.
- Frequency of calls by cruise vessels equipped to connect to Shore Power.
- Availability of the same dock and pier facility for these vessels for every call.
- Adequate dock and uplands space for equipment.
- Willing partners including – utility, port and government agencies.

CRUISE SHIP SHORE POWER PROJECT

JUNEAU, ALASKA

Cruise Ship Shore Power Project Juneau, Alaska

First High Voltage Shore Power Connection
for Cruise Ships



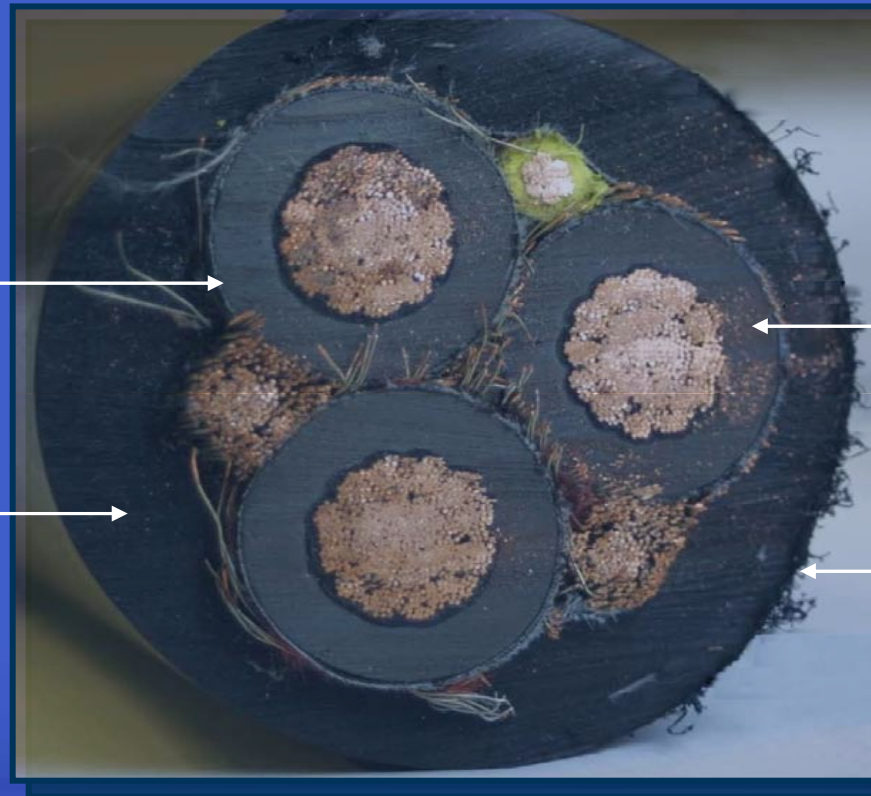
Cruise Ship Shore Power Project Juneau, Alaska

Power Cables

AmeriCable 350 KCMIL 15kV SHD-GC CPE

15kV 350
MCM Cu
Conductor

Grounding
Conductor



EPR
Insulation

CPE
Jacket

Cruise Ship Shore Power Project Juneau, Alaska

Substation Construction



Cruise Ship Shore Power Project Juneau, Alaska

Setting Transformer



Cruise Ship Shore Power Project Juneau, Alaska

Excavation of Cable Trench



Cruise Ship Shore Power Project Juneau, Alaska

Boring Under Road



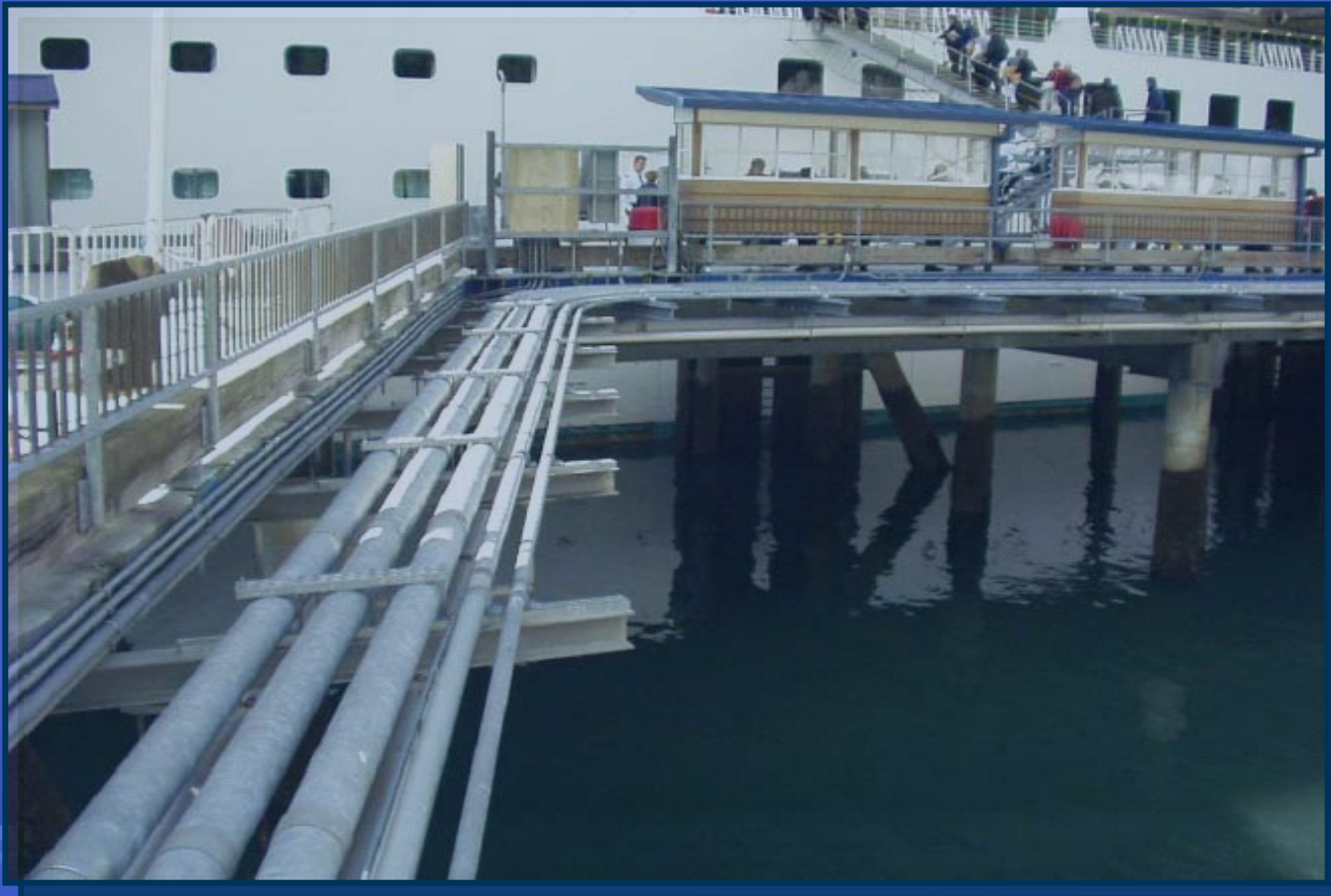
Cruise Ship Shore Power Project Juneau, Alaska

Substation 6.6 & 11 KV Breakers



Cruise Ship Shore Power Project Juneau, Alaska

Conduit Installation on Dock



Cruise Ship Shore Power Project Juneau, Alaska

Lowering Shore Power Cables



Cruise Ship Shore Power Project Juneau, Alaska



*Festooning
System
Allows for
Cable
Adjustment
for Tidal
Fluctuations*

Cruise Ship Shore Power Project Juneau, Alaska



Cruise Ship Shore Power Project Juneau, Alaska

Design & Construction Timing

- Notice to Proceed Given by Princess
December 1, 2000
- On Line Early June 2001

Cruise Ship Shore Power Project Juneau, Alaska

Electrical Energy Sales In Juneau, Alaska

- Ship Hotel Electrical Loads 7 to 11 MW @ 6.6 KV or 11 KV and .83 to .86 PF
- Total Annual Shore Power Consumption is 11 - 12 GWH Annually

CRUISE SHIP SHORE POWER PROJECT

SEATTLE, WASHINGTON

Cruise Ship Shore Power Project Seattle, Washington

T-30

Transformer, Main & Secondary Metering Equipment



Cruise Ship Shore Power Project Seattle, Washington



Cruise Ship Shore Power Project Seattle, Washington

Festooning System



Cruise Ship Shore Power Project Seattle, Washington

Electrical Energy Sales In Seattle, Washington

Transformer Capacity:

- 16.25 Megawatts.
- Total annual consumption 3.5 – 4 GWH.

Dual Service Delivery (Secondary) Voltage:

- 6.6kv and 11kv depending on class of ship.
- Both voltages are not used at the same time.

In Seattle the Primary Voltage is 27kv.

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CRUISE SHIP SHORE POWER PROJECTS

SHORESIDE INSTALLATION

Mike Watts

Manager, Special Projects Division
Cochran, Inc.

Cruise Ship Shore Power Project

Shoreside Installation

Shore Power Description

Power is transmitted from an onshore substation equipped with a dual voltage transformer that will supply power to 11kV or 6.6kV class ships.

Internal shore side monitoring and protection is achieved with protection relays to insure safety and protection of both ship and shore electrical systems..

Flexibility to connect either 11kV or 6.6kV ships is achieved by two independent secondary breakers with Kirk-Key interlocks.

Power is carried to the ship through five flexible "Ship Cables" routed through a grounding switch.

This grounding switch works in conjunction with the ships automation system to ensures safety and reliability during the cable handling from shore to ship.

Cruise Ship Shore Power Project Shoreside Installation

Step 1 – Electrical Design

Step 2 – Procurement

Step 3 – Installation

Step 4 – Commissioning & Testing

Cruise Ship Shore Power Project Shoreside Installation

Design Process

- Meet with utility company to determine source of power.
- Field survey & agree on location of equipment.
- Perform load calculations & place equipment on drawings.
- Design is generated & forwarded to local jurisdiction for approval.

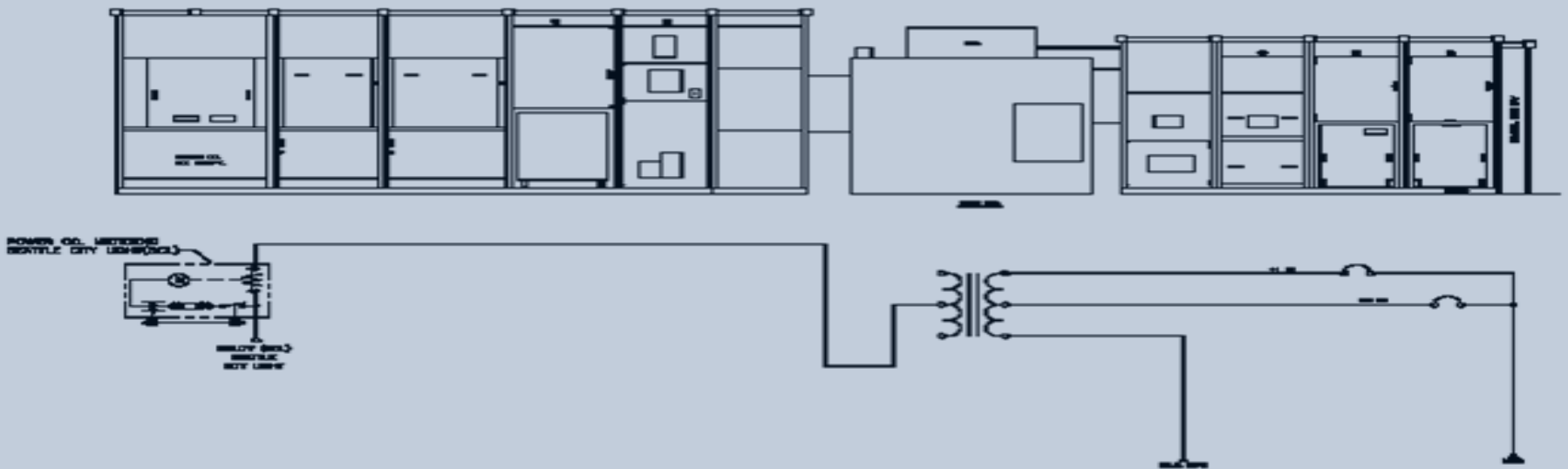
Cruise Ship Shore Power Project Shoreside Installation

System Components

- Transformer
- Main Metering Equipment
- Secondary Metering Equipment
- Grounding Switch
- Shore Power Cable Winch
- Power Cables

Cruise Ship Shore Power Project Shoreside Installation

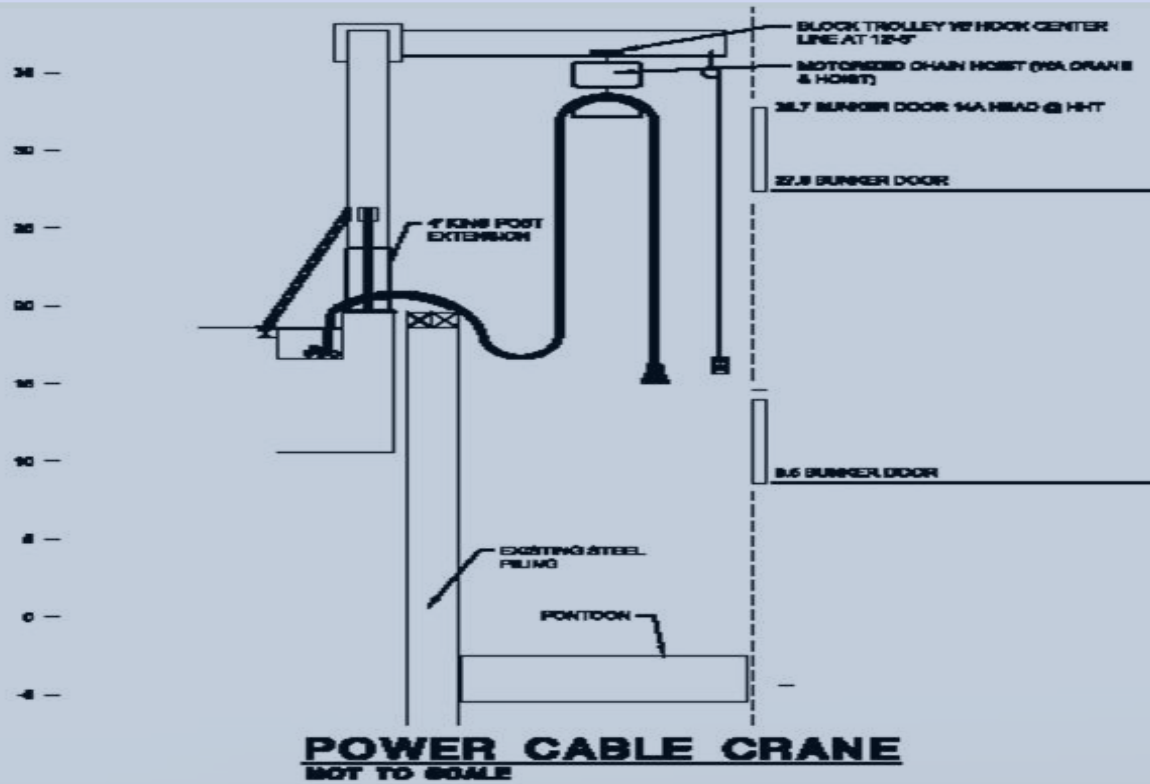
Design



ONE-LINE DIAGRAM
NOT TO SCALE

Cruise Ship Shore Power Project Shoreside Installation

Design



Cruise Ship Shore Power Project Shoreside Installation

Procurement Process

- Approved design is sent to manufacturer
- Manufacturer revises designs based on local conditions and requirements
- Shop drawings are submitted for approval
- Shop drawings are approved and production begins

Cruise Ship Shore Power Project Shoreside Installation

Transformer, Main & Secondary Metering Equipment



Cruise Ship Shore Power Project Shoreside Installation

Ground Switch



Cruise Ship Shore Power Project Shoreside Installation

Power Cable Winch



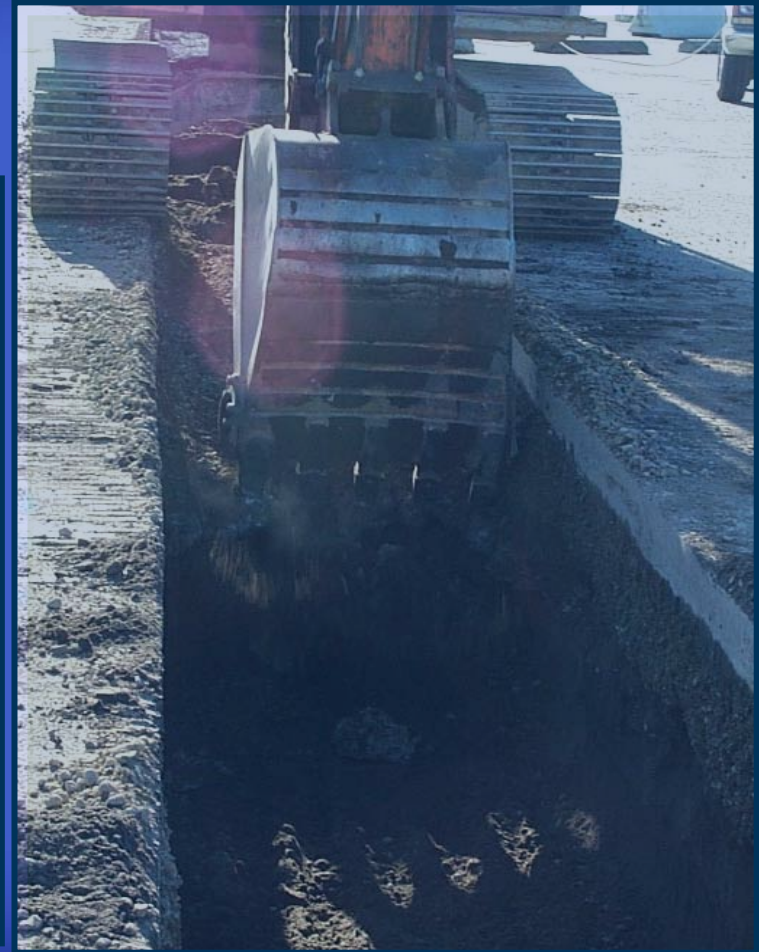
Cruise Ship Shore Power Project Shoreside Installation

Installation

- Excavation
- Conduit Installation
- Transformer Pad Installation.
- Equipment Installation
 - Transformer
 - Main Metering Equipment;
 - Secondary Metering Equipment;
 - Grounding Switch; & Cable Winch
- Cable Installation

Cruise Ship Shore Power Project Shoreside Installation

Excavation



Cruise Ship Shore Power Project Shoreside Installation

Conduit



Cruise Ship Shore Power Project Shoreside Installation



Transformer Pad



Cruise Ship Shore Power Project Shoreside Installation

Equipment



Cruise Ship Shore Power Project Shoreside Installation

Cable



Cruise Ship Shore Power Project Shoreside Installation

Commissioning & Testing Process

- Ship is docked
- Winch lowers cables into hull & cables are attached
- Testing is completed to ensure entire system is functional
- Commissioning is completed

CRUISE SHIP SHORE POWER PROJECT

SHIPBOARD INSTALLATION

Per Thunem

**VP of Systems & Technologies
Callenberg Engineering Inc.**

Cruise Ship Shore Power Project Shipboard Installation

Shipboard Control Panel



Cruise Ship Shore Power Project Shipboard Installation



INCOMING
SHORE
CONNECTION
CUBICLE WITH
CIRCUIT
BREAKER AND
HV COUPLERS

Cruise Ship Shore Power Project Shipboard Installation



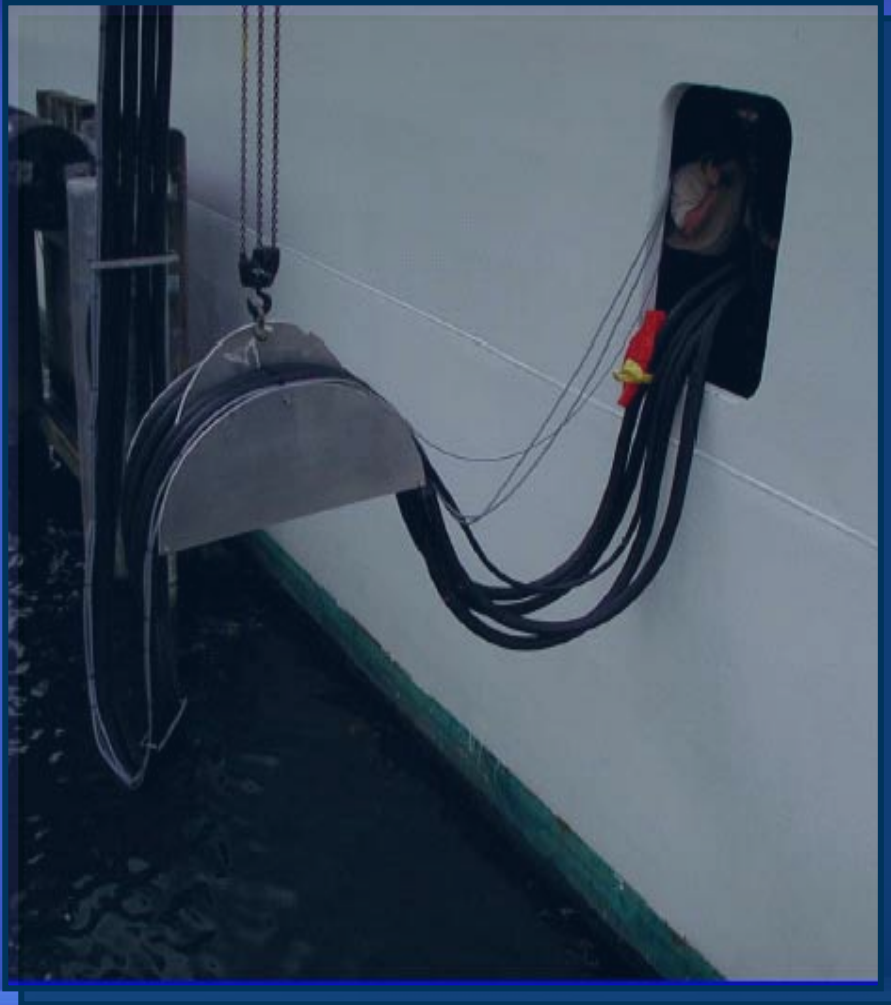
Shipboard Cables Connections

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

Cruise Ship Shore Power Project Shipboard Installation



Cruise Ship Shore Power Project Shipboard Installation



CABLES FROM
SHORE SIDE

Cruise Ship Shore Power Project Shoreside Installation



Cruise Ship Shore Power Project

Shipboard Installation

Shipboard Automation

- Shipboard Automatic Synchronization
- Real and Reactive Load Transfer Rates
- Less Than 500 KW and 500 KVARs Separation
- Ship to Shore Isolation (Fault or other Protective Perimeters)
- No Shipboard Manual Controls
- Standardization of Shipboard Programming

Cruise Ship Shore Power Project Shipboard Installation

Ship to Shore SCADA & Control Interface

- RS-485 4-wire communications link
- Modbus is used for SCADA Communications Protocol
- Modbus Register Addressing
- Ship to Shore Permissives and Protection are hard wired
- Ship to Shore Standardization

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CRUISE SHIP SHORE POWER PROJECT

BIOGRAPHIES

Dean C. Brown

EVP of Shore Operations, Princess Cruises & CEO, Princess Tours

Dean Brown was appointed Princess Cruises' executive vice president of shore operations in February 2004, bringing his 25 years of company experience to this position he is responsible for the operation of the line's shoreside activities.

Brown oversees all aspects of the Princess and Cunard global port operations, On Board Revenue activities and continues as chief executive officer of Princess Tours, the subsidiary company that develops, operates and markets cruisetour vacations.

Throughout his career with Princess, he has had responsibility for a wide array of operational areas, and was recently executive vice president of customer service and sales, a position he was appointed to in 2000. In this post he oversaw the sales policies and distribution of the Princess product as well as travel agent support activities. He has been a visible Princess representative throughout the industry.

Brown has served two terms as chairman of the North West CruiseShip Association (NWCA). Prior to this appointment he served as the organization's vice chairman and chairman of finance. Brown has served on the Executive Committee of Cruise Lines International Association (CLIA), and represents Princess and Cunard with the International Council of Cruise Lines (ICCL). He also served on the board of directors of the Alaska Visitors Association (AVA) for more than 10 years, holding the position of AVA president in 1996.

A native of Washington, he attended the University of Washington where he received his B.A. degree in communications and history. He and his wife, Susan, have three children and reside in the Los Angeles area.

Michael Watts
Manager, Special Projects Division
Cochran, Inc.

Mike Watts is the Manager of the Special Projects Division for Cochran, Inc., a Commercial Electrical Contractor located in Seattle, WA. He has worked extensively in the electrical industry for over 20 years, serving in a variety of positions including Foreman, General Foreman, Superintendent and Project Manager.

Mike joined Cochran in 1999 as a Project Manager. In his current position as Special Projects Division Manager, Mike has direct responsibility for the supervision of the Special Projects and Service Division teams. Mike closely manages the project teams during design and construction as they work with clients through the construction process. Mike is also responsible for overseeing the daily responsibilities of contract negotiations, estimating, project management (both on-site and in office) service dispatching and purchasing as well as monthly reports and fiscal budgets.

Mike also manages the Cochran Marine Division and is responsible for the sale and promotion of Cochran designed shore power installations for ships docked at ports throughout the country.

Per Thunem

VP of Systems & Technologies

Callenberg Engineering Inc.

Per Thunem, VP Systems & Technologies of Callenberg Engineering, has 34 years experience within the marine industry. He started his career working through the various disciplines at shipyards in Norway.

In 1980 Per joined a 6 months retrofit project of a cruise ship in Germany. For the following 7 years he sailed with the vessel, until he decided to go ashore and joined Callenberg Engineering. After 2 years with Callenberg, Per was offered position as electrical superintendent with Royal Caribbean Cruise line. After 9 years he rejoined Callenberg Engineering, where he has been working mostly as systems engineer.

During this period, Per designed and implemented the first fully automatic medium voltage shore connection system. The system was installed onboard four ships for Princess Cruises. The concept was very successful, and Princess Cruises decided to install the same system on all new builds. This system is currently installed onboard 9 Princess ships, and two ports have built substations supporting the vessels, as well as Victoria Shipyard.

Per graduated after studying electronic engineering for 4 years in Norway. He and his family – wife and 2 daughters – currently live in Miami, Florida.