

Efficient Pollution-Free Steam Generation with Medium Voltage Boilers

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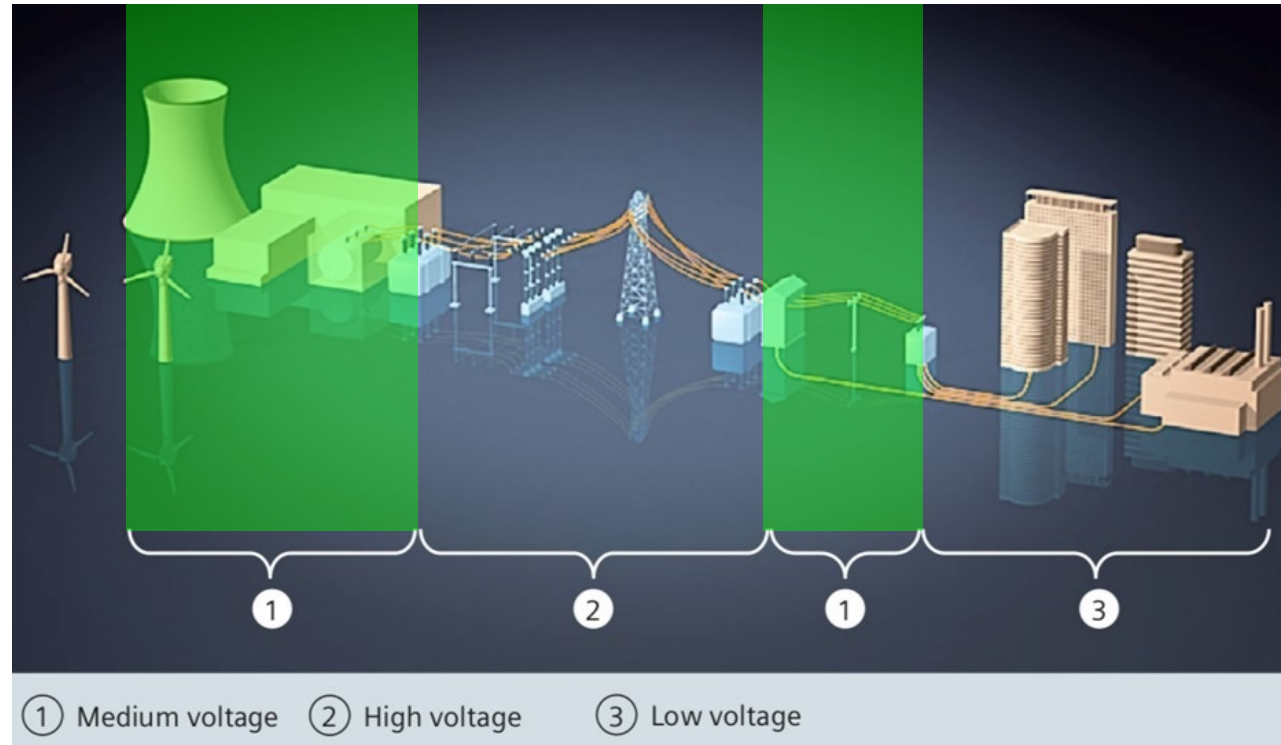


Medium Voltage – What is it?

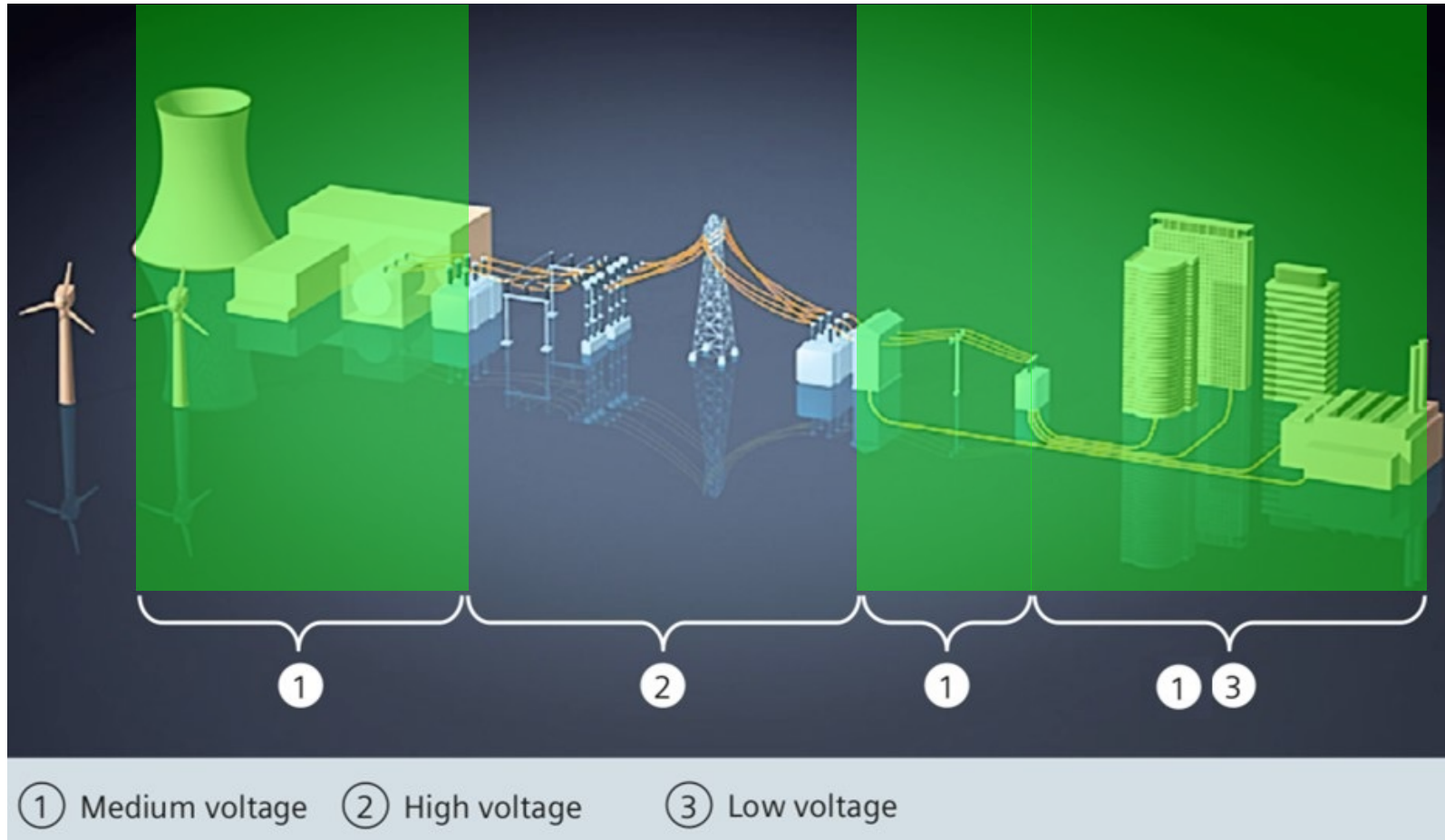
Medium Voltage = 1kV to 69kV

High Voltage = 69kV+

Low Voltage = <1,000V

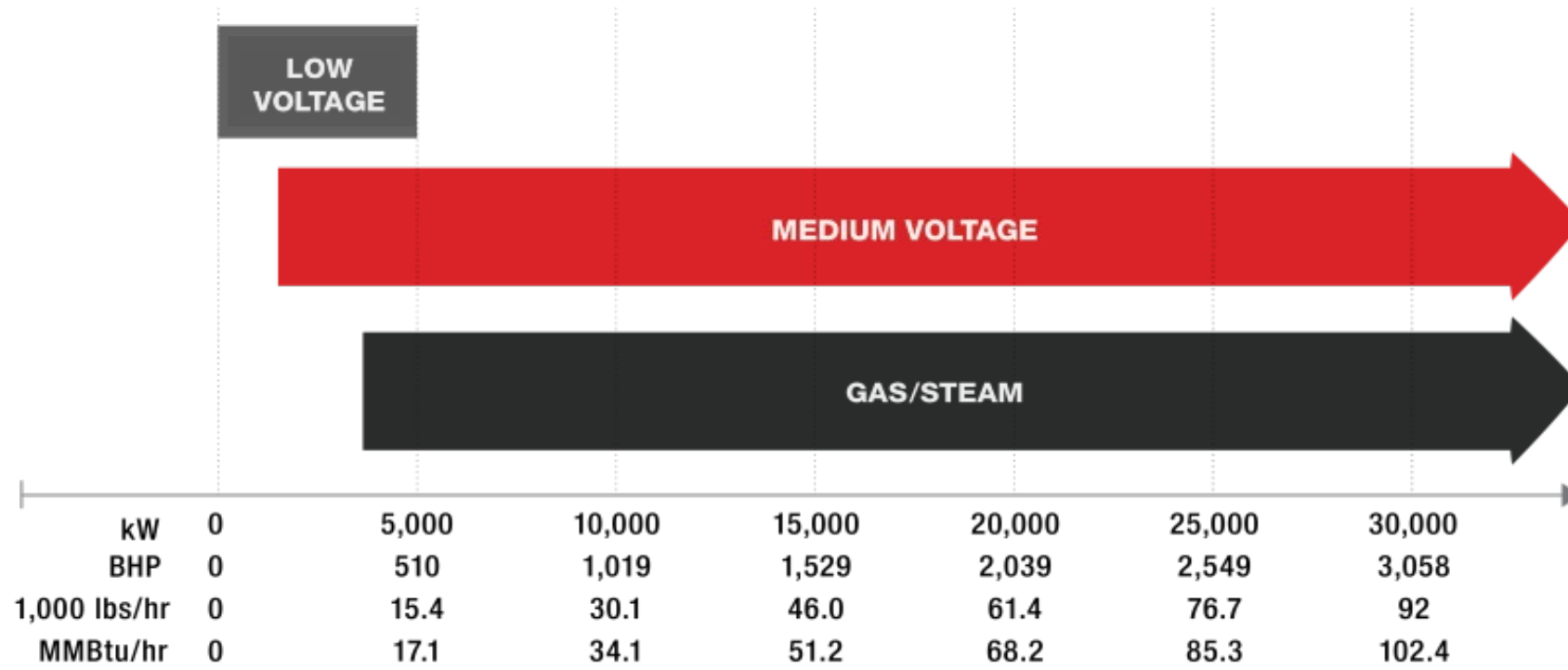


Industrial and Commercial Applications for MV



Optimal Choice for Steam Generation

- Utilizing medium voltage electric power is a cost-effective solution for large steam flow rate demands
- Medium voltage provides all the same “green” benefits as low voltage heating



Benefits of Electric Heating



Lowered Safety Concerns

No open flames



Increased Efficiency

Nearly 100% of energy utilized is converted to heat energy



Minimal Maintenance

Combustion controls that need adjusting; easily replaceable, if needed



Clean Operation & Lower Installation Costs

No pollution stacks, fuel lines or holding tanks



Precise Temperature Control

Electric allows point of use installation with a power control input range of 0% to 100%, no wasted energy



Controlled Costs

Low fluctuations in electricity prices



Medium Voltage vs. Fossil Fuel Fired Heating

- 99% Efficient – no flue stack losses
- Reduced heater footprint, weight savings
- Minimal maintenance – no moving parts
- Rapid heat up and response time
- Precise temperature control – SCR/Thyristor proportional
- Utilization of low cost / excess electricity generated by renewable energy sources
- Zero onsite emissions – no need for pollution permitting

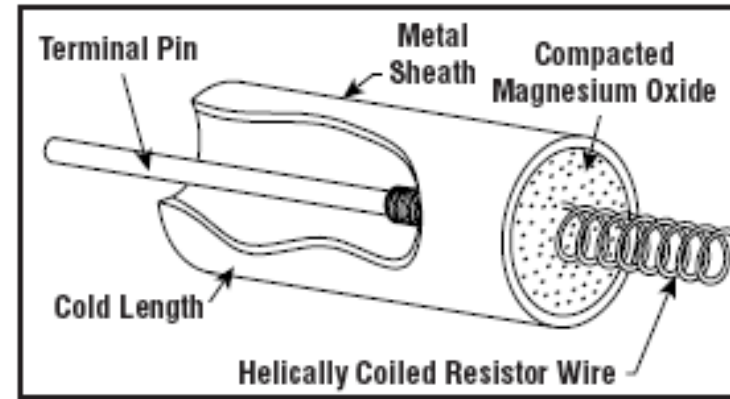


VS.

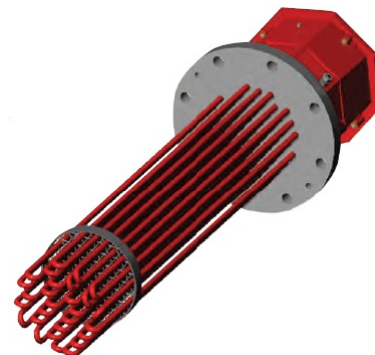


What is an electric heating element?

- Resistor (Ni Chrome Wire)
- Insulator (MgO)
- Container (Tubing)
- Cold Pin and Termination



Low Voltage Heating Element



Low Voltage vs. Medium Voltage Elements

Low Voltage

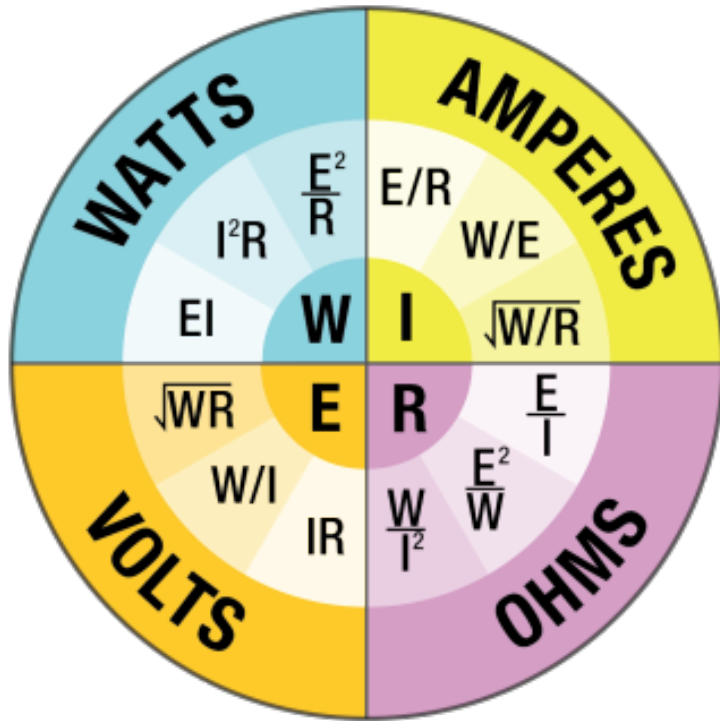
- Up to 1,000V (690V)
- 95.7% efficient
- .475" diameter elements
- .028" sheath thickness
- 2,928V hi pot for 480V
- 3rd party certs: UL, CSA, ATEX, IECex
- 1MW @415V = 1,493 amps
- 1.4MW SCR Panel Dimensions:
112" W x 20" D x 90" H

Medium Voltage

- 1,000 to 7,200 Volts
- 98.8% efficient
- .994" diameter elements
- .05" sheath thickness
- 15,400V hi pot for 6600V
- 3rd party certs: UL, ETL, ATEX, IECex
- 1MW @ 6600V = 88 amps
- 1.4MW SCR panel dimensions:
90" W x 30" D x 93" H



How does MV reduce installation costs?



Case Study:

Typical Plant Service: 400-690V and 4160-6600V

Ohm's Law: $\text{kW} / \text{Voltage} / 1.73 = \text{Amperage}$

ex. 3,230kW at 380 V, ~4900 amps, 63 circuits

3,230kW at 6600V, ~280 amps, 3 circuits

*Using medium voltage eliminates 60 circuits worth of wire, contactors, fusing, and installation labor.

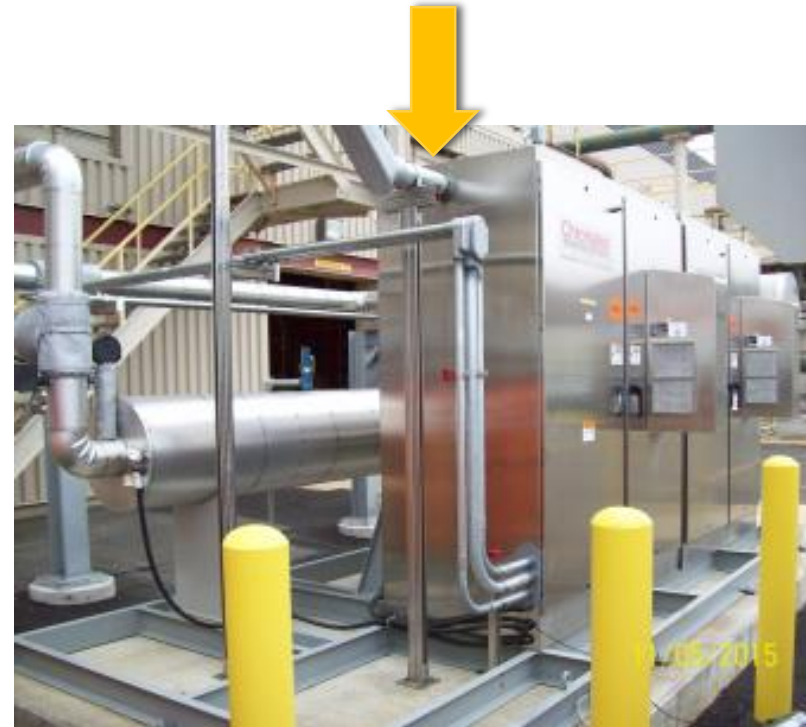
Utilizing MV reduces the amperage demand over **17X!**



DirectConnect MV – Installation Savings



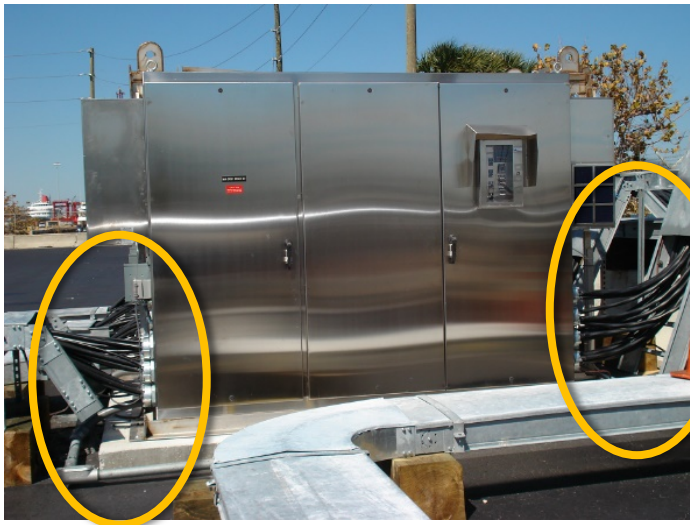
Single conduit feed for (2) circuit,
2MW 4160V



2MW 4160V Water Heating Skid System

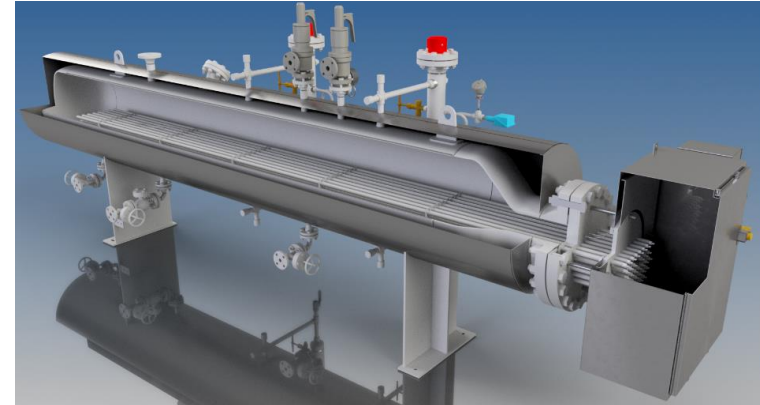


10MW 600V Salt Water Heating System



DirectConnect Medium Voltage Boilers

- Pressure Code
 - ASME, Section 1
 - 'S' Stamp
 - Up to 450 PSIG Standard, Option for 1000 PSIG
- Electrical Code
 - Heater is IEC Certified
 - Indoor or Outdoor Installation
- Boiler Components – Carry applicable certifications
- Panel – IEC rated up to 7.2 kV, UL certifies up to 5kV

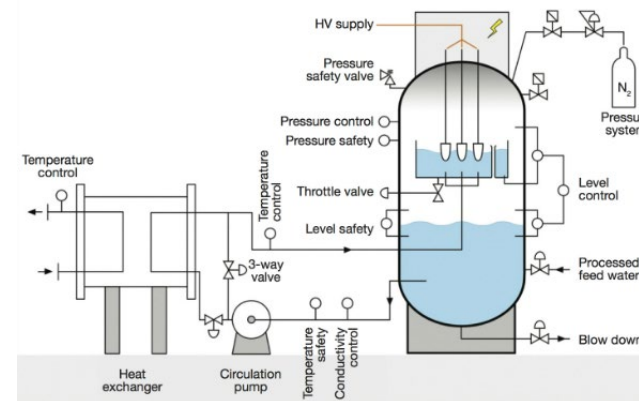
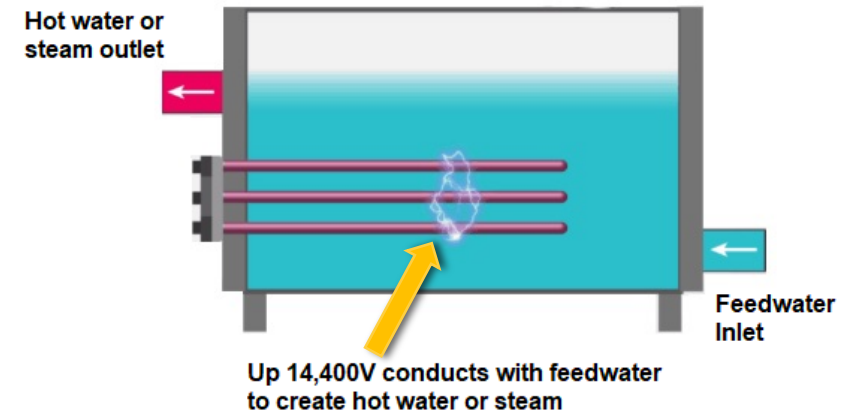


Medium Voltage Boilers – Electrode Boilers

Electrode Boilers:

- Electrodes pass electric current through water to generate steam
- Water treatment required
- Liquid level sensing and control required
- Corrosion concern with electrodes and electrical isolation insulators
- Scaling and deposits on spray nozzles will reduce boiler output

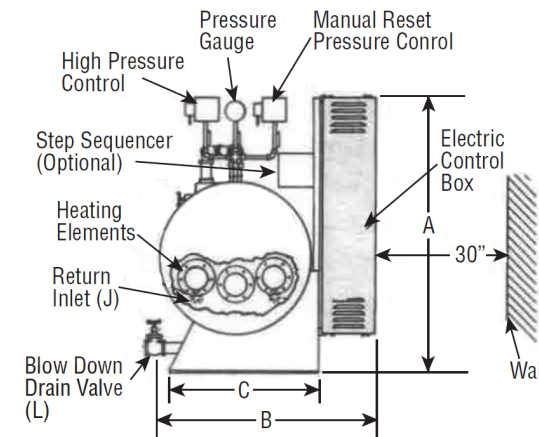
Simplified Electrode Boiler Drawing



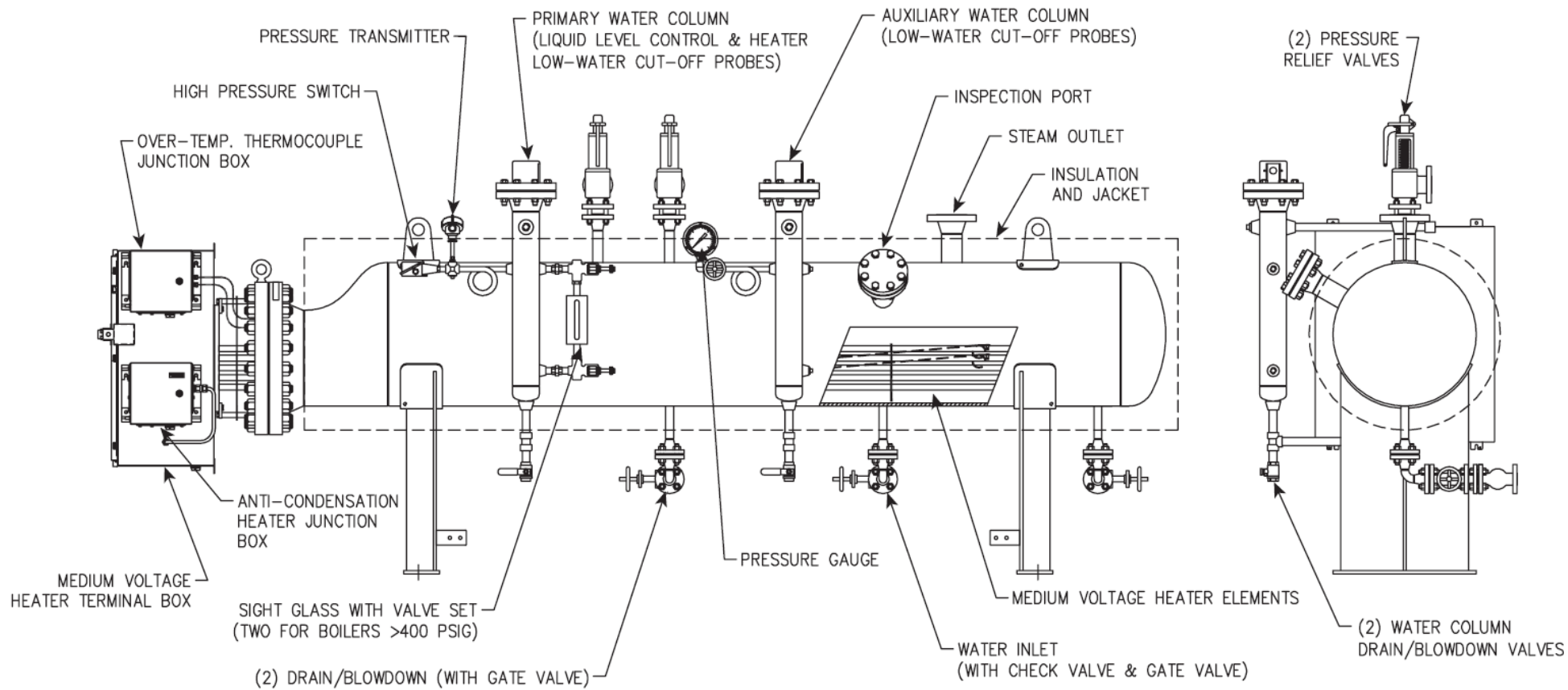
Steam Generation with Resistance Heaters

Benefits of using resistance heating to generate steam:

- Very little to zero water treatment required
- Able to utilize DI or de-min feedwater supply
- Electrical connections isolated from internal boiler vessel
- Simple control scheme based on outlet pressure sensor
- Corrosion resistant Incoloy sheathed heating elements
- Minimal maintenance due to zero moving parts required for operation
- Nearly 100% efficient
- 450 PSIG standard designs, up to 1000 PSIG custom designs available



DirectConnect MV Boiler Sample Drawing



Petrochemical Processing Market

Electric Heating Applications

- Steam Generators
- Fuel Gas Heaters
- Regeneration Heaters
- Thermal Fluid Heaters
- Vaporizers
- Hydrocarbon Gas Superheaters
- NGL Feed Heaters
- Steam, Air, N₂, H₂ Superheaters
- Condensate / NGL Stabilizers
- TEG Reboilers
- Cryo Fluid Heaters
- Seal Gas Heaters
- Chlorination Heaters
- Temperature Maintenance - Heat Trace Systems



MV Steam Generation – Future Considerations

- Utilizing electric heating and control systems is not new technology for the Petrochemical and Chemical processing industries
- Medium voltage is a safe and efficient energy source for steam generation and process heating applications
- Medium voltage heating systems offer significant installation and operation savings compared to large low voltage electric heating systems
- Medium voltage heating systems can replace or supplement fossil fuel fired heating systems for increased efficiency and reduced on-site pollution emissions

