Agenda

- **Background**
  - Natural Gas Basics
  - Existing & Future Natural Gas Supply to BPPS
  - West East II Pipeline

- **Natural Gas Quality**
  - Gas Receiving Station Process

- **Gas Turbine at Black Point Power Station (BPPS)**
  - Fuel Gas Nozzles
  - Gas Heating for Quality Treatment

- **Fuel Quality Management System (FQMS)**
  - FQMS Process

- **Fuel Flexibility**
  - Existing MWI Operating Range
  - New Operating Range with FQMS
Background
Natural Gas Basics

- Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane (C\textsubscript{1}), but also including varying amounts of other hydrocarbons (C\textsubscript{2} – C\textsubscript{6+}), carbon dioxide, nitrogen and hydrogen sulfide.

- Commonly used for domestic use (cooking & heating), electricity generation, vehicle fuel; also used as feedstock in Gas to Liquid (GTL) process

- Liquified Natural Gas – also known as LNG where natural gas is condensed into a liquid at close to atmospheric pressure by cooling it to approximately $-162^\circ$C.
Existing & Future Natural Gas Supply to BPPS

- Current BPPS Gas Supply from Yacheng at Hainan, Y13-1 (780km).
- Future gas supply to BPPS will be by West East II Pipeline from Turkmenistan.
- Peak Shaving by a proposed LNG Terminal in Shenzhen
PetroChina’s 2nd West-East Gas Pipeline

- The project includes 1 trunkline and 8 branches.
- China’s first major energy project to transfer natural gas from outside PRC.
- From Khorgos Port (Xinjiang) to Guangzhou, Shanghai and Hong Kong.

Second West to East Pipeline Route

Total length: ~8,600km
Capacity: ~30Bcm/yr
Gas Quality
Natural Gas Quality

- **Physical cleanliness**: Amount of foreign materials presented in the gas, i.e. debris from pipeline
  - Problem can be solved with filters

- **Total Sulphur**
  - Taken care by gas supplier at upstream with Sulphur removal facilities to maintain Sulphur under an mutually agreed level.

- **Gas Compositions and corresponding heating value & density**
  - Wobbe index of a specific natural gas = HHV / \( \sqrt{S.G} \)
  - The Wobbe index is a measurement of the degree to which fuels with different compositions such as natural gas and propane can be interchanged
  - Gas with different compositions but same Wobbe Index usually can be used in the same appliance
New GRS Process Flow
Overview of Gas Receiving Station
Gas Turbine at BPPS
Fuel Gas Nozzles

\[
MWI = \frac{LHV}{\sqrt{SG_{gas} \times T_{gas}}}
\]

- LHV = lower heating value of gas fuel (Btu/scf)
- \(SG_{gas}\) = specific gravity of gas fuel relative to air
- \(T_{gas}\) = absolute temperature of gas fuel (°R)

- Measure of interchangeability for heavy duty GE gas turbines defined by Modified Wobbe Index (MWI)
- There are other fuel gas criteria that must be met as well as MWI
Gas Heating for Quality Treatment

Modified Wobbe Index vs. Temperature (°C)

- Pipeline Gas
- Lean LNG
- Rich LNG
- Rich +
Fuel Quality Management System
Fuel Quality Management System (FQMS) Design Schematic
FQMS Process Flow

- **Chromatographs (GE)**
- **Flow Range**: 150 to 50% of GT total
- **Flow Meter**
- **Gas Blending System (GE)**
- **Flow Range**: 0 to 50% of GT total
- **FCV**
- **PCV**
- **Potential Base Heaters (if Electric Heater Decommissioned)**
- **Existing Filter Separator**
- **Existing Electric Gas Heater**
- **LP FW Gas Heater**
- **TCV “Cold”**
- **TCV “Hot”**
- **LP feed water from HRSG**
- **LP feed water return stream**

**CLP**

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FQMS at BPPS
Fuel Flexibility
Existing MWI Operating Range for BPPS

- Current BPPS Gas Supply from Yacheng at Hainan, Y13-1 (780km).
- Equipped with Electric Heater which can heat the gas to 55°C to prevent Sulphur deposition
- Cannot deal with natural gas with potentially changing compositions, i.e. changing MWI at constant temperature
MWI Operating Range for BPPS with FQMS

- Potential new nozzle gas ratings (47.8 Btu/scf R½)
- Blue box operating range
- 25°C exit temperature from GRS
- 120°C maximum gas heating temperature

![Graph showing MWI operating range for BPPS with FQMS]
End