HYDROGEN ENERGY CALIFORNIA

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MITSUBISHI HEAVY INDUSTRIES, LTD.

Hydrogen Energy California Update

GASIFICATION TECHNOLOGIES CONFERENCE

October 29-31, 2012

PRESENTATION OUTLINE

- **Project History**
- **Commercial Update**
- **Permitting Update**
- **What Remains the Same**
- **What Has Changed**
- **Technical Details of the New Configuration**

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Project History

- BP and Rio Tinto
  - Carson Hydrogen Power, BP Carson Refinery
  - Hydrogen Energy
  - Rio Tinto became a partner
  - HECA - present location adjacent to Elk Hills
  - GE gasification technology
  - GE 7F Syngas gas turbine
- SCS Energy
  - PurGen One, New Jersey
  - MHI gasification technology
  - MHI 501G gas turbine
  - Co-Production of Urea

Commercial Update

- BP Alternative Energy and Rio Tinto sold Hydrogen Energy California to SCS Energy in 2011.
- Hydrogen Energy California modified the project configuration, changing gasification technology suppliers and adding the co-production of fertilizers - solid urea and urea ammonium nitrate solution.
- Hydrogen Energy California and the Department of Energy modified the Clean Coal Power Initiative Round 3 (CCPI 3) cooperative funding agreement to reflect the modified project configuration.
- The Hydrogen Energy California Project will be funded with a combination of debt and equity.
- Fluor and MHI are executing Front End Engineering and Design.

Permitting Update

- Hydrogen Energy California submitted an amended Application for Certification to the California Energy Commission on May 2, 2012
- URS is performing permitting services with engineering support by Fluor and MHI
- Permitting is expected to take 12 months
- The Owner is responding to Data Requests from the California Energy Commission and others

EMISSIONS – NEW VERSUS OLD

Projected Emissions (Tons/Year)
partial Table 1-1 (excerpt from Application For Certification)

	NO_X	CO	VOC	SO_2	PM_{10}	$PM_{2.5}$
Amended AFC (April 2012)	163.7	275.2	35.4	29.4	90.3	80.2
SJVAPCD Final Determination of Compliance (December 2010)	195.9	407.0	59.1	38.3	91.7	not stated

EXPECTED EMISSIONS & CONTROL METHODS

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Combined Gas Turbine/HRSG and Coal Drying Exhausts:

- NO_X 2.5 ppm
  - Gas Turbine Diluent (Nitrogen) Injection & Selective Catalytic Reduction
- CO 3 ppm
  - High-Hydrogen Fuel, Good Combustion Practices & Oxidation Catalyst
- VOC 1 ppm
  - Low-VOC Fuel, Good Combustion Practices & Oxidation Catalyst
- SO_2 <0.4 ppm (concentration varies, mass flow is constant)
  - Removal of sulfur compounds from the syngas in the AGR
- Mercury <0.003 lb/GWh
  - Meets new Mercury and Air Toxics Standards (MATS) limit for new IGCC facilities
  - Removal of Mercury from Syngas with Activated Carbon or Activated Alumina
  - Removal of Mercury from the Coal Drying Exhaust using Activated Carbon

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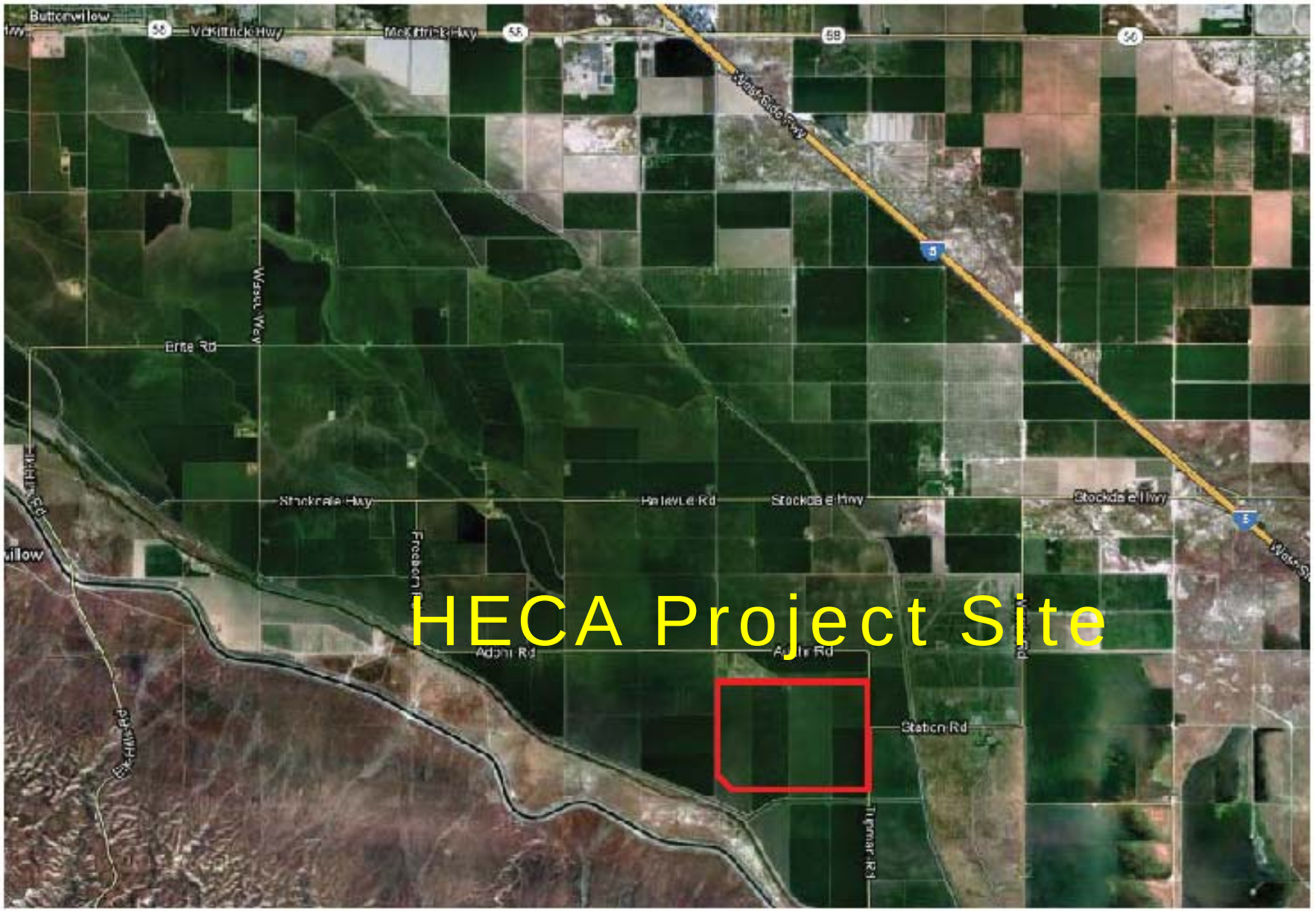
What Remains the Same

- The project site is the same. The site is about 120 miles northwest of Los Angeles and about 20 miles west of downtown Bakersfield.
- The project continues to use IGCC technology.
- The project will capture 90% of the carbon in the syngas. Carbon dioxide will be transported via pipeline to the Occidental Elk Hills Oil Field where it will be sequestered as part of the enhanced oil recovery operation.
- Process water requirements are supplied from brackish ground water. The project incorporates zero liquid discharge in the design.

PROJECT LOCATION



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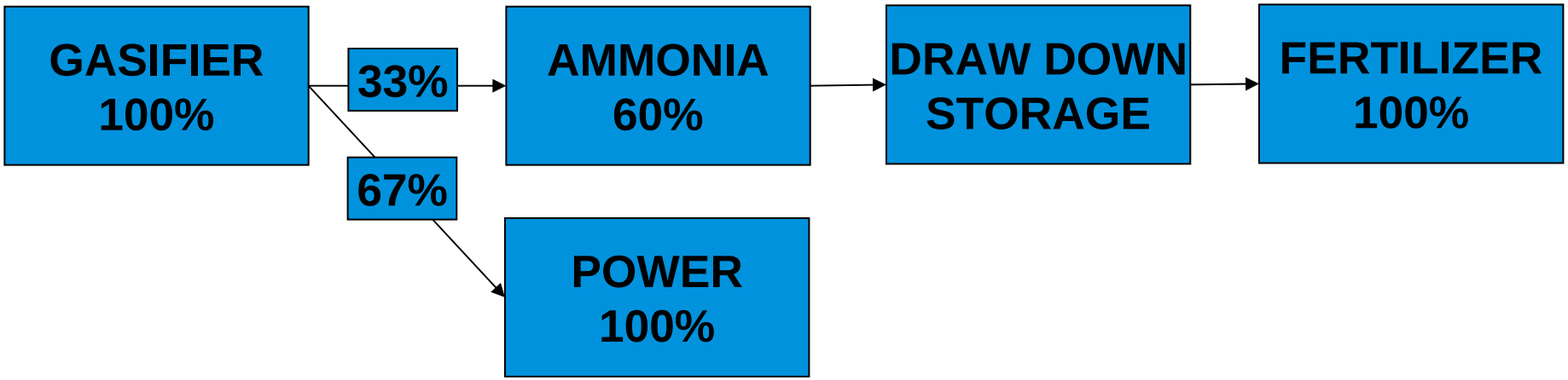
What Has Changed

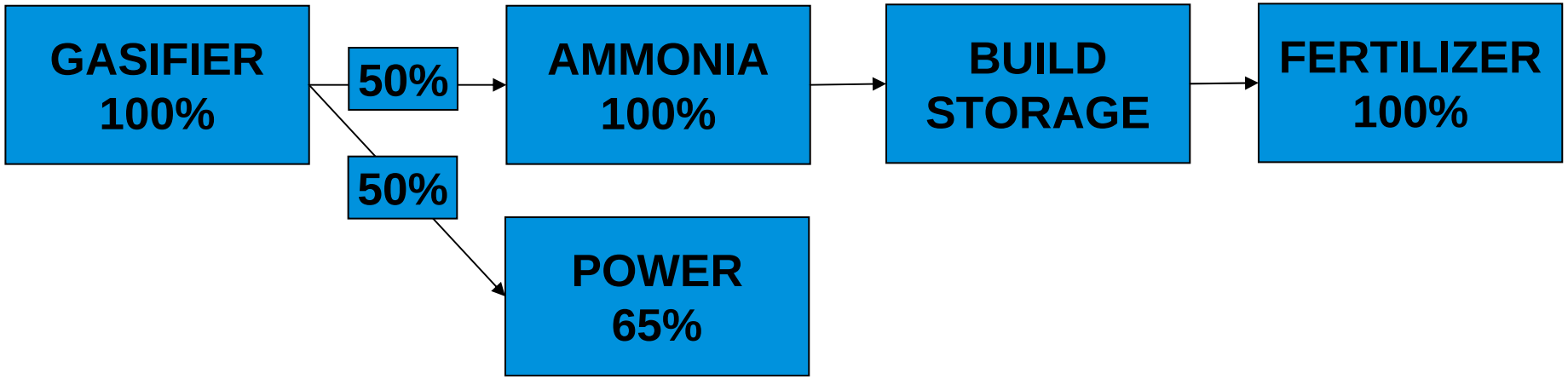
- The Mitsubishi Heavy Industries (MHI) will supply a single oxygen-blown gasifier. Syngas production has increased by about 40% compared to the previous configuration.
  - One MHI Gasifier (no spare)
  - MHI Water-Cooled Membrane Wall – Improved Availability
  - MHI Two-Stage – Improved Efficiency
- The project will use the MHI 501GAC gas turbine in single-shaft configuration (GT/ST/G).
- The project now includes the co-production of fertilizers: solid urea and urea ammonium nitrate solution. Ammonia is produced from the shifted syngas (hydrogen) and then converted to the final fertilizer products.
- The power block output will vary daily between 100% load and about 65% load. Intermediate ammonia production will swing inversely to power from 60% to 100%. The gasifier will operate at 100% capacity continuously.
- A portion of the captured carbon dioxide is used as feedstock for urea and the remainder is used for enhanced oil recovery.
- Solid urea and urea ammonium nitrate solution production will operate continuously at 100% capacity at a rate consistent with the average ammonia production rate.

DAILY OPERATION MODES

- MAXIMUM POWER PRODUCTION (16 Hours/Day)



- MAXIMUM AMMONIA PRODUCTION (8 Hours/Day)



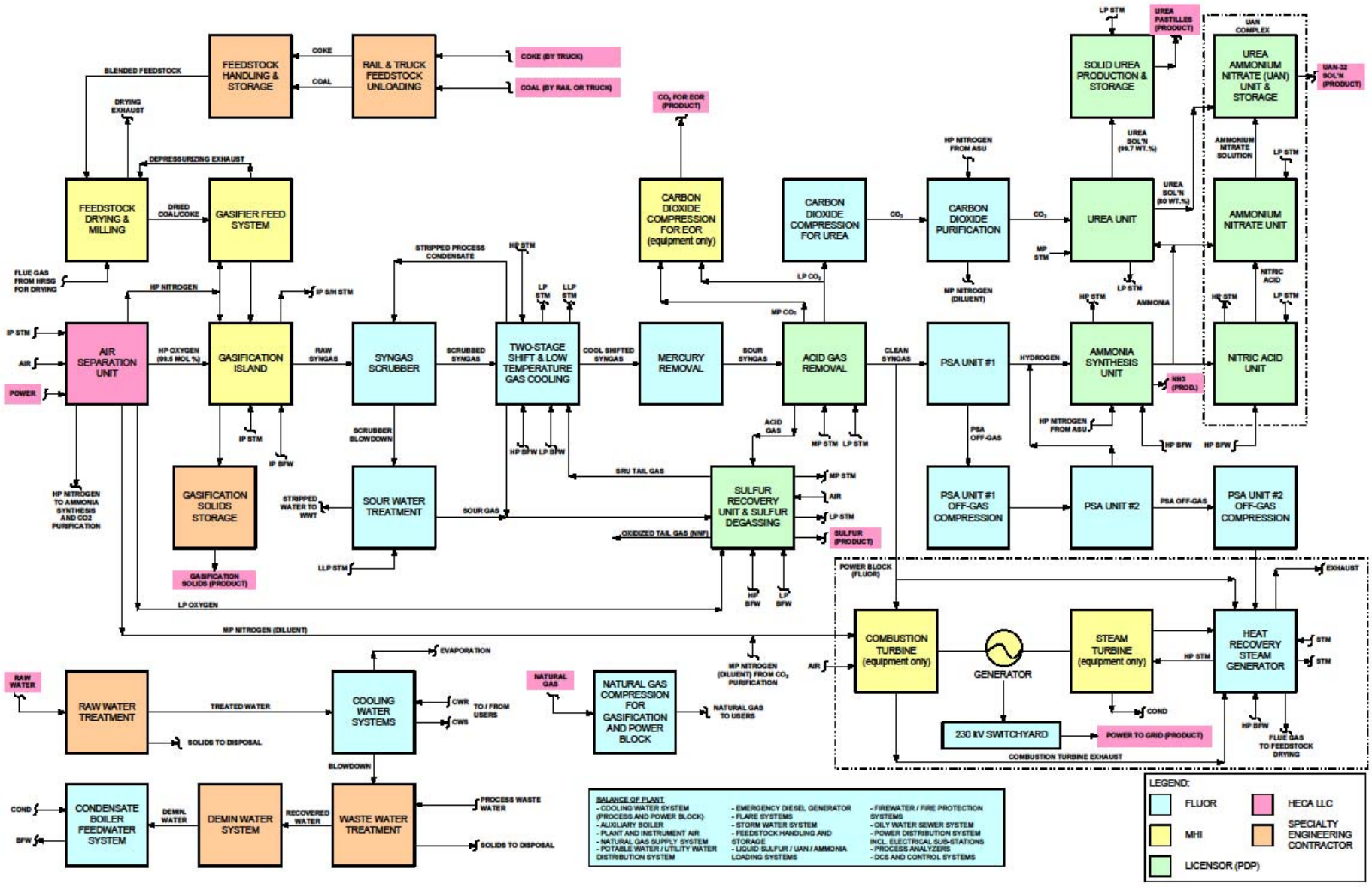
DAILY OPERATION CYCLES

- On a daily average basis, about 60% of the syngas is used to produce power.
- <u>MAXIMUM POWER PRODUCTION (16 Hours/Day)</u>
  - Gasifier through AGR operates at 100%
  - About 67% of syngas goes to the power block
  - PSA and ammonia plant operate at 60%
  - Urea and UAN operate at 100% and draw down from intermediate ammonia storage
- <u>MAXIMUM AMMONIA PRODUCTION (8 Hours/Day)</u>
  - Gasifier through AGR operates at 100%
  - About 50% of syngas goes to the power block
  - PSA and ammonia plant operate at 100%
  - Urea and UAN operate at 100% and inventory builds in intermediate ammonia storage

Technical Details of the New Configuration

- Gasification Capacity:
  - 275 x 10^6 SCFD of Hydrogen + Carbon Monoxide
  - Feedstock Input: 5,720 Tons per Day (As Received)
- Net Power Output:
  - Maximum Power Mode: up to 300 MW
  - Maximum Ammonia Mode: nominally 165 MW
- Ammonia Capacity: 2080 tons/day
- Urea Capacity:
  - Total Urea: 2208 tons/day
  - Solid Urea Product: 1700 tons/day
  - Urea to UAN: 508 tons/day
- Nitric Acid Capacity (Intermediate Only): 488 tons/day (100% basis)
- Urea Ammonium Nitrate (UAN-32) Solution Capacity: 1400 tons/day

Technical Details of the New Configuration



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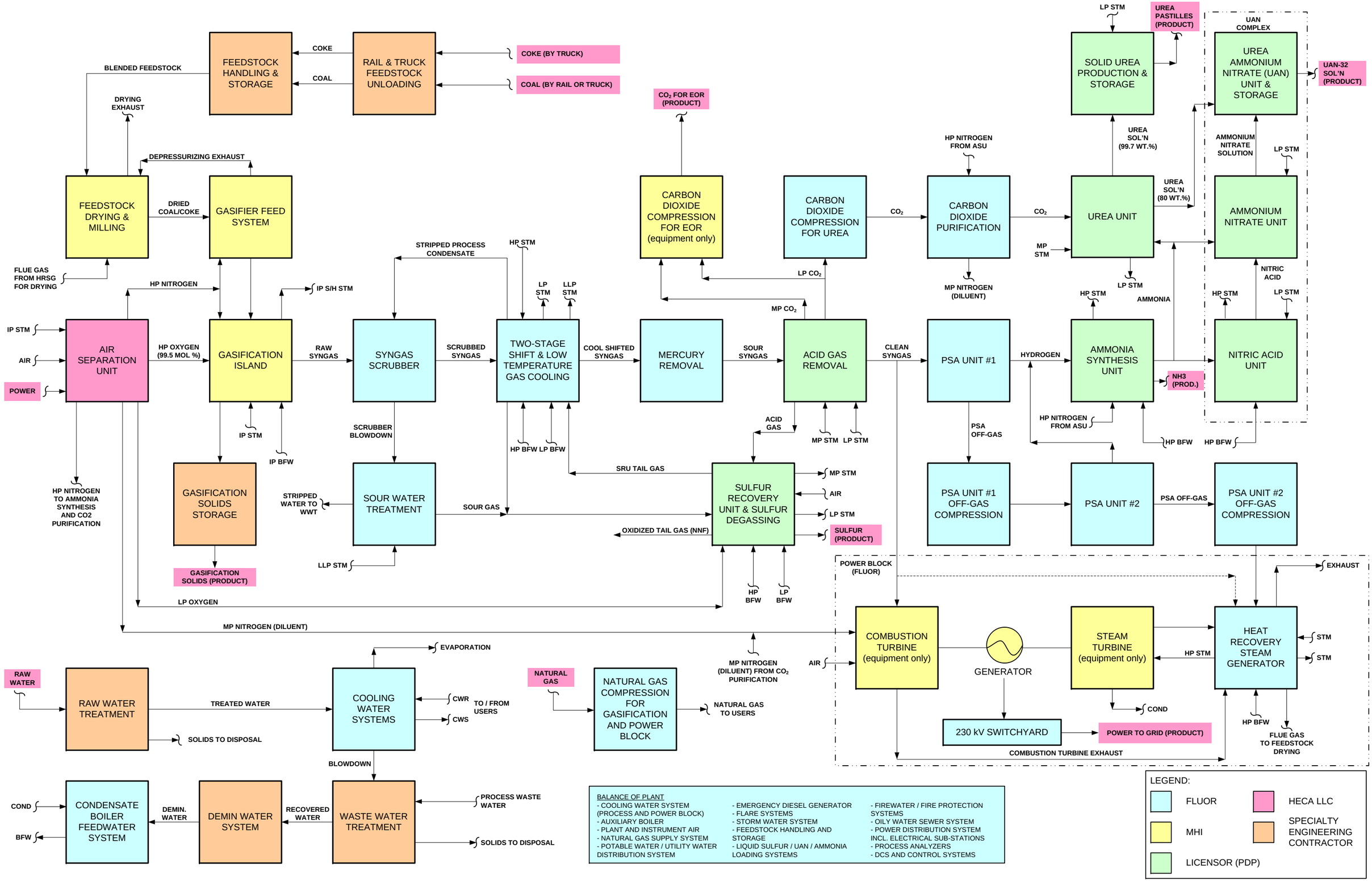
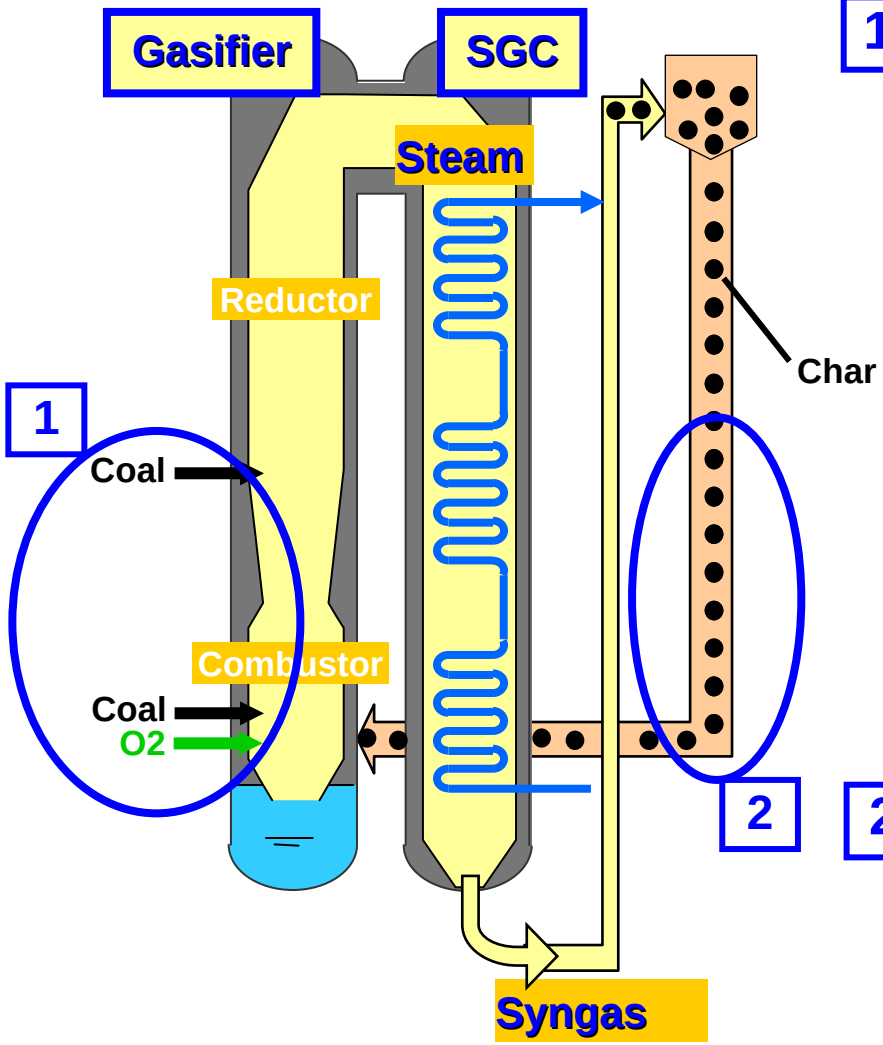

FEEDSTOCK HANDLING & STORAGE
COKE
COAL
RAIL & TRUCK FEEDSTOCK UNLOADING
COKE (BY TRUCK)
COAL (BY RAIL OR TRUCK)
BLENDED FEEDSTOCK
DRYING EXHAUST
DEPRESSURIZING EXHAUST
FEEDSTOCK DRYING & MILLING
DRIED COAL/COKE
GASIFIER FEED SYSTEM
FLUE GAS FROM HRSG FOR DRYING
HP NITROGEN
IP S/H STM
IP STM
AIR
POWER
AIR SEPARATION UNIT
HP OXYGEN (99.5 MOL %)
GASIFICATION ISLAND
RAW SYNGAS
SYNGAS SCRUBBER
SCRUBBED SYNGAS
STRIPPED PROCESS CONDENSATE
HP STM
LP STM
LLP STM
TWO-STAGE SHIFT & LOW TEMPERATURE GAS COOLING
COOL SHIFTED SYNGAS
MERCURY REMOVAL
SOUR SYNGAS
ACID GAS REMOVAL
CLEAN SYNGAS
PSA UNIT #1
HYDROGEN
AMMONIA SYNTHESIS UNIT
NH3 (PROD.)
NITRIC ACID UNIT
HP NITROGEN TO AMMONIA SYNTHESIS AND CO2 PURIFICATION
IP STM
IP BFW
GASIFICATION SOLIDS STORAGE
GASIFICATION SOLIDS (PRODUCT)
SCRUBBER BLOWDOWN
STRIPPED WATER TO WWT
SOUR WATER TREATMENT
LLP STM
HP BFW LP BFW
SRU TAIL GAS
SOUR GAS
OXIDIZED TAIL GAS (NNF)
SULFUR RECOVERY UNIT & SULFUR DEGASSING
MP STM
AIR
LP STM
SULFUR (PRODUCT)
HP BFW
LP BFW
ACID GAS
MP STM
LP STM
PSA OFF-GAS
PSA UNIT #1 OFF-GAS COMPRESSION
PSA UNIT #2
PSA OFF-GAS
PSA UNIT #2 OFF-GAS COMPRESSION
HP NITROGEN FROM ASU
HP BFW
HP BFW
LP OXYGEN
MP NITROGEN (DILUENT)
CO_2 FOR EOR (PRODUCT)
CARBON DIOXIDE COMPRESSION FOR EOR (equipment only)
CARBON DIOXIDE COMPRESSION FOR UREA
CO_2
CARBON DIOXIDE PURIFICATION
CO_2
LP CO_2
MP CO_2
HP NITROGEN FROM ASU
MP NITROGEN (DILUENT)
MP STM
UREA UNIT
LP STM
AMMONIA
HP STM
LP STM
UREA PASTILLES (PRODUCT)
SOLID UREA PRODUCTION & STORAGE
UREA SOL'N (99.7 WT.%)
UREA SOL'N (80 WT.%)
UAN COMPLEX
UREA AMMONIUM NITRATE (UAN) UNIT & STORAGE
UAN-32 SOL'N (PRODUCT)
AMMONIUM NITRATE SOLUTION
LP STM
AMMONIUM NITRATE UNIT
NITRIC ACID
HP STM
LP STM
HP NITROGEN FROM ASU
HP BFW
HP BFW
POWER BLOCK (FLUOR)
EXHAUST
COMBUSTION TURBINE (equipment only)
AIR
GENERATOR
STEAM TURBINE (equipment only)
HP STM
HEAT RECOVERY STEAM GENERATOR
STM
STM
COND
230 kV SWITCHYARD
POWER TO GRID (PRODUCT)
HP BFW
FLUE GAS TO FEEDSTOCK DRYING
COMBUSTION TURBINE EXHAUST
RAW WATER
RAW WATER TREATMENT
TREATED WATER
SOLIDS TO DISPOSAL
EVAPORATION
COOLING WATER SYSTEMS
CWR
CWS
TO / FROM USERS
BLOWDOWN
NATURAL GAS
NATURAL GAS COMPRESSION FOR GASIFICATION AND POWER BLOCK
NATURAL GAS TO USERS
MP NITROGEN (DILUENT) FROM CO_2 PURIFICATION
COND
BFW
CONDENSATE BOILER FEEDWATER SYSTEM
DEMIN. WATER
DEMIN WATER SYSTEM
RECOVERED WATER
WASTE WATER TREATMENT
PROCESS WASTE WATER
SOLIDS TO DISPOSAL
BALANCE OF PLANT
- COOLING WATER SYSTEM (PROCESS AND POWER BLOCK)
- AUXILIARY BOILER
- PLANT AND INSTRUMENT AIR
- NATURAL GAS SUPPLY SYSTEM
- POTABLE WATER / UTILITY WATER DISTRIBUTION SYSTEM
- EMERGENCY DIESEL GENERATOR
- FLARE SYSTEMS
- STORM WATER SYSTEM
- FEEDSTOCK HANDLING AND STORAGE
- LIQUID SULFUR / UAN / AMMONIA LOADING SYSTEMS
- FIREWATER / FIRE PROTECTION SYSTEMS
- OILY WATER SEWER SYSTEM
- POWER DISTRIBUTION SYSTEM INCL. ELECTRICAL SUB-STATIONS
- PROCESS ANALYZERS
- DCS AND CONTROL SYSTEMS
LEGEND:
FLUOR
MHI
LICENSOR (PDP)
HECA LLC
SPECIALTY ENGINEERING CONTRACTOR

MHI O2 blown Gasifier

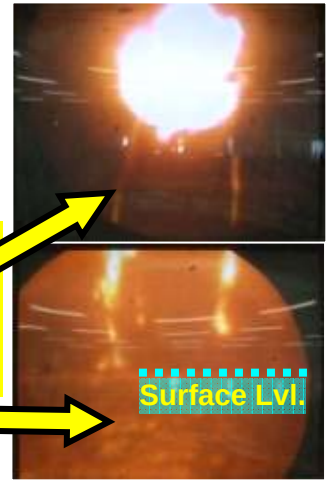


1 2-Staged Gasification

- Stable syngas production and smooth slag discharge for wide variety of coal

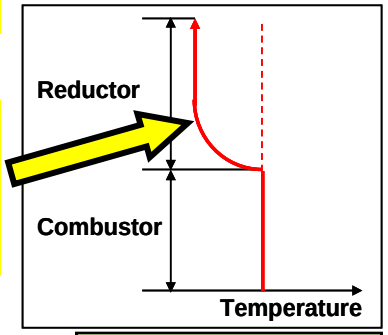
Slag smoothly flowing down through the "slag hole" in 2 streams

Slag cooled down in the "water bath"



- No quench gas Injection

Chemical quench w/o gas occurs in Reductor



2 Char Recycling System

- Minimize unburnt carbon in slag (Carbon conversion rate > 99.9%)
- No black water from gasifier

Same 2-staged gasifier as Air-Blown Nakoso IGCC project applied to O2-Blown

- Without changing the basic design of the existing gasifier in operation
- Reducing O2 consumption by 15-25%
- SGC, as monolithic structure with gasifier, producing steam and increasing power output from PowerBlock

250MW IGCC Demonstration Plant - Targets & Accomplishments -

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		Targets	Achievements	Note
Performance	Output	250MW	250MW	
	Efficiency (Net, LHV)	> 42.0%	42.9%	
	Carbon Conversion	> 99.9%	> 99.9%	
Emission (@dry, 16%O2)	SOx	< 8 ppm	1.0 ppm	
	NOx	< 5 ppm	3.4 ppm	
	Dust	< 4 mg/M3n	< 0.1 mg/m^{3}N	
Operational Flexibility	Coal Kinds	Bituminous Sub-bituminous	Chinese, PRB 3 Indonesian Subs Colombian, Russian	Continuously expanding
	Start-up Time	< 18 hr	15 hr	
	Minimum Load	50%	Less than 50% (36%)	
	Ramping Rate	3%/min	3%/min	
Reliability	Long-term Continuous Operation	2,000 hr	2,238 hr	
	Long-Term Reliability Run	5,000 hr	5,013 hr	
	Availability (Feb.2011-Jan.2012)		84 %	Except Tsunami and scheduled shutdown

- All of the demonstration targets have been achieved.
- Future plan focuses on the further improvement of operational flexibility.

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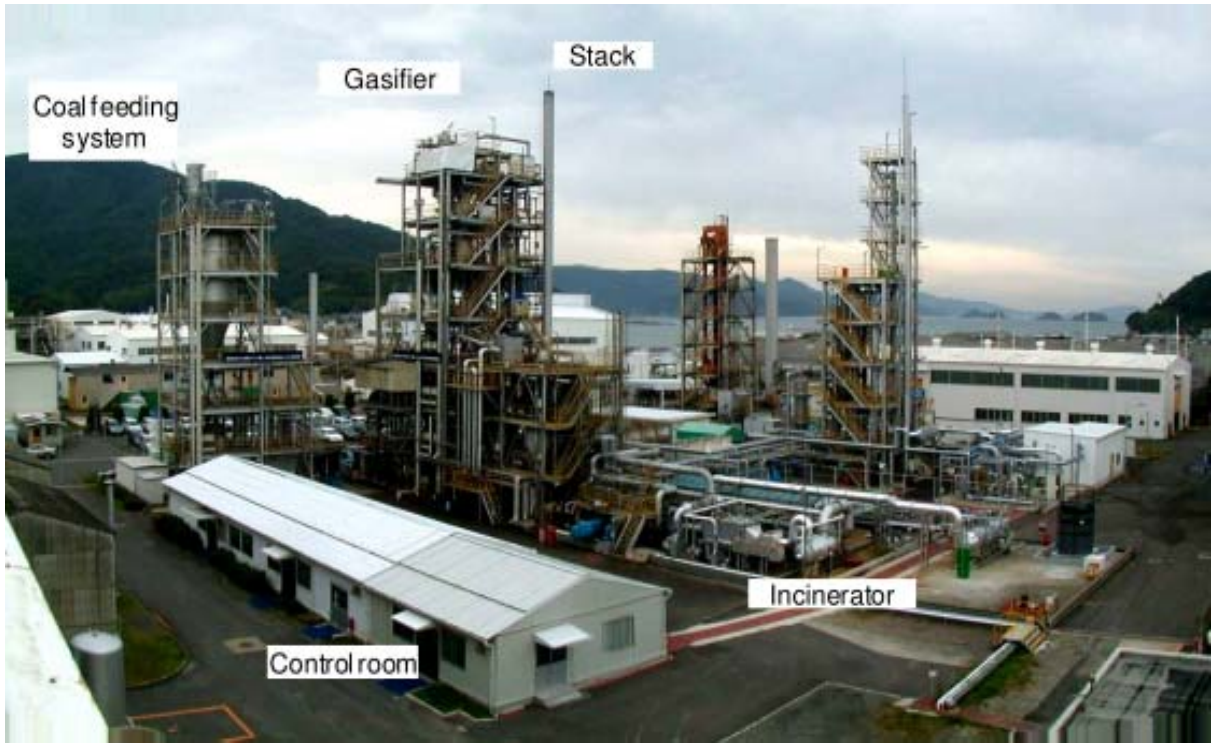
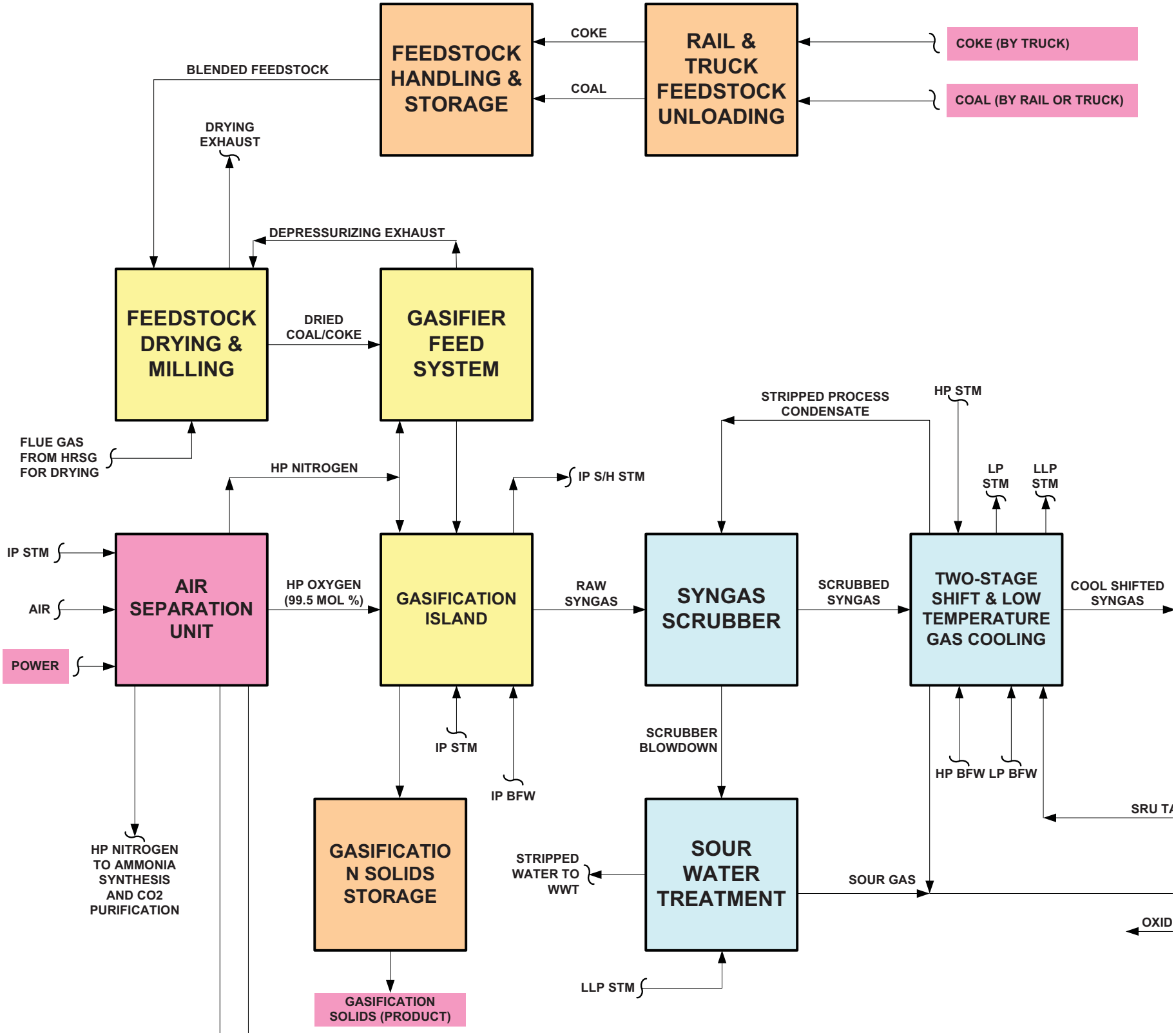
Initial Feedstock Testing Completed



- **Feedstock Tests Complete: 133 Tons of Coal and Coke**
- **Gasifier type : Oxygen-Blown**
- **Coal Capacity : 50 T/D**
- **Location: MHI Nagasaki R&D Center**


FEEDSTOCK HANDLING & STORAGE
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RAIL & TRUCK FEEDSTOCK UNLOADING
COKE (BY TRUCK)
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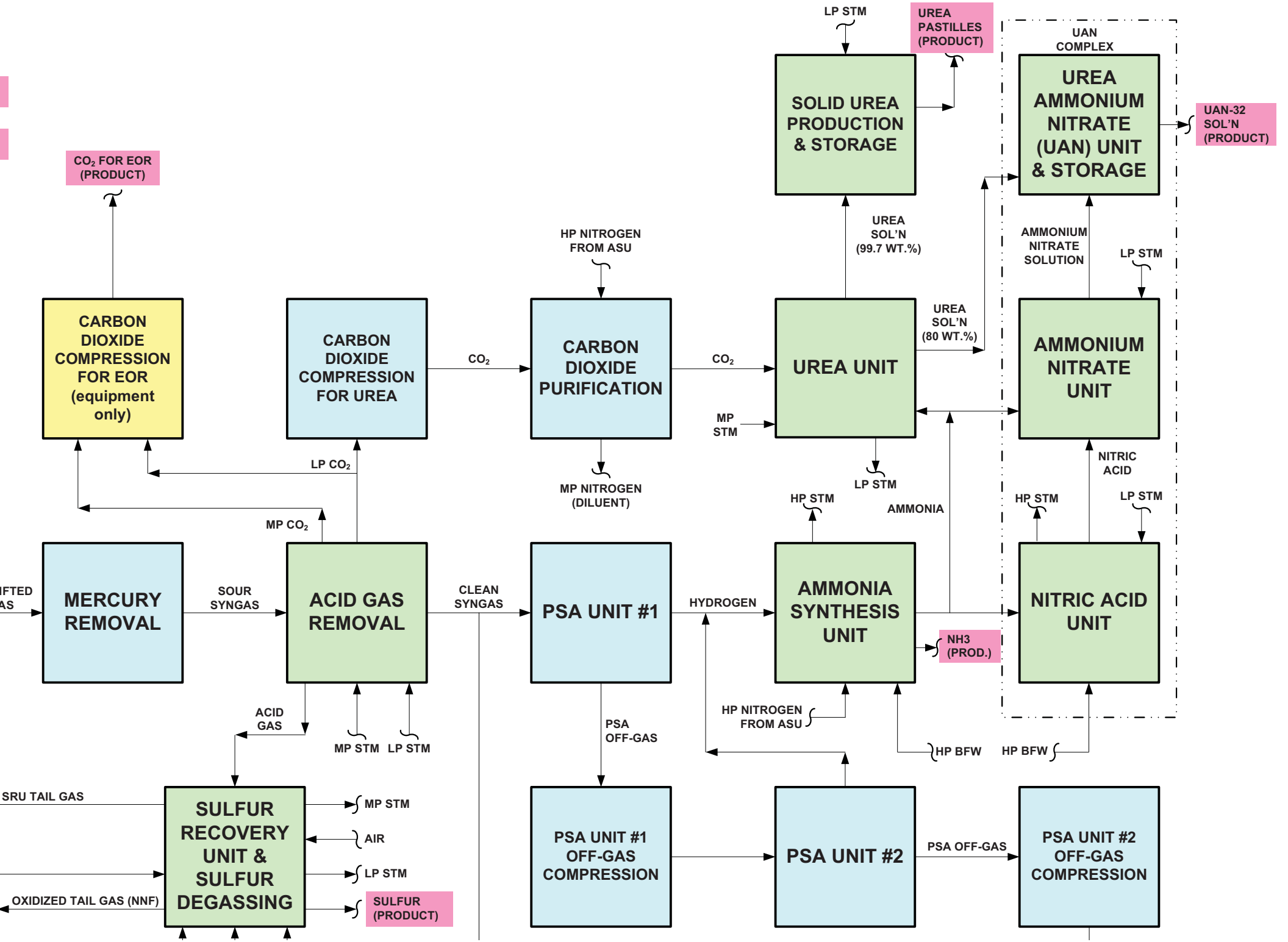
STRIPPED WATER TO WWT
SOUR WATER TREATMENT
SOUR GAS
OXID
LLP STM
GASIFICATION SOLIDS (PRODUCT)


LP STM
UREA PASTILLES (PRODUCT)
UAN COMPLEX
SOLID UREA PRODUCTION & STORAGE
UREA AMMONIUM NITRATE (UAN) UNIT & STORAGE
UAN-32 SOL'N (PRODUCT)
CO_2 FOR EOR (PRODUCT)
HP NITROGEN FROM ASU
UREA SOL'N (99.7 WT.%)
AMMONIUM NITRATE SOLUTION
LP STM
CARBON DIOXIDE COMPRESSION FOR EOR (equipment only)
CARBON DIOXIDE COMPRESSION FOR UREA
CO_2
CARBON DIOXIDE PURIFICATION
CO_2
UREA UNIT
UREA SOL'N (80 WT.%)
AMMONIUM NITRATE UNIT
MP STM
LP CO_2
MP NITROGEN (DILUENT)
LP STM
NITRIC ACID
HP STM
AMMONIA
HP STM
LP STM
MP CO_2
MERCURY REMOVAL
SOUR SYNGAS
ACID GAS REMOVAL
CLEAN SYNGAS
PSA UNIT #1
HYDROGEN
AMMONIA SYNTHESIS UNIT
NITRIC ACID UNIT
NH3 (PROD.)
ACID GAS
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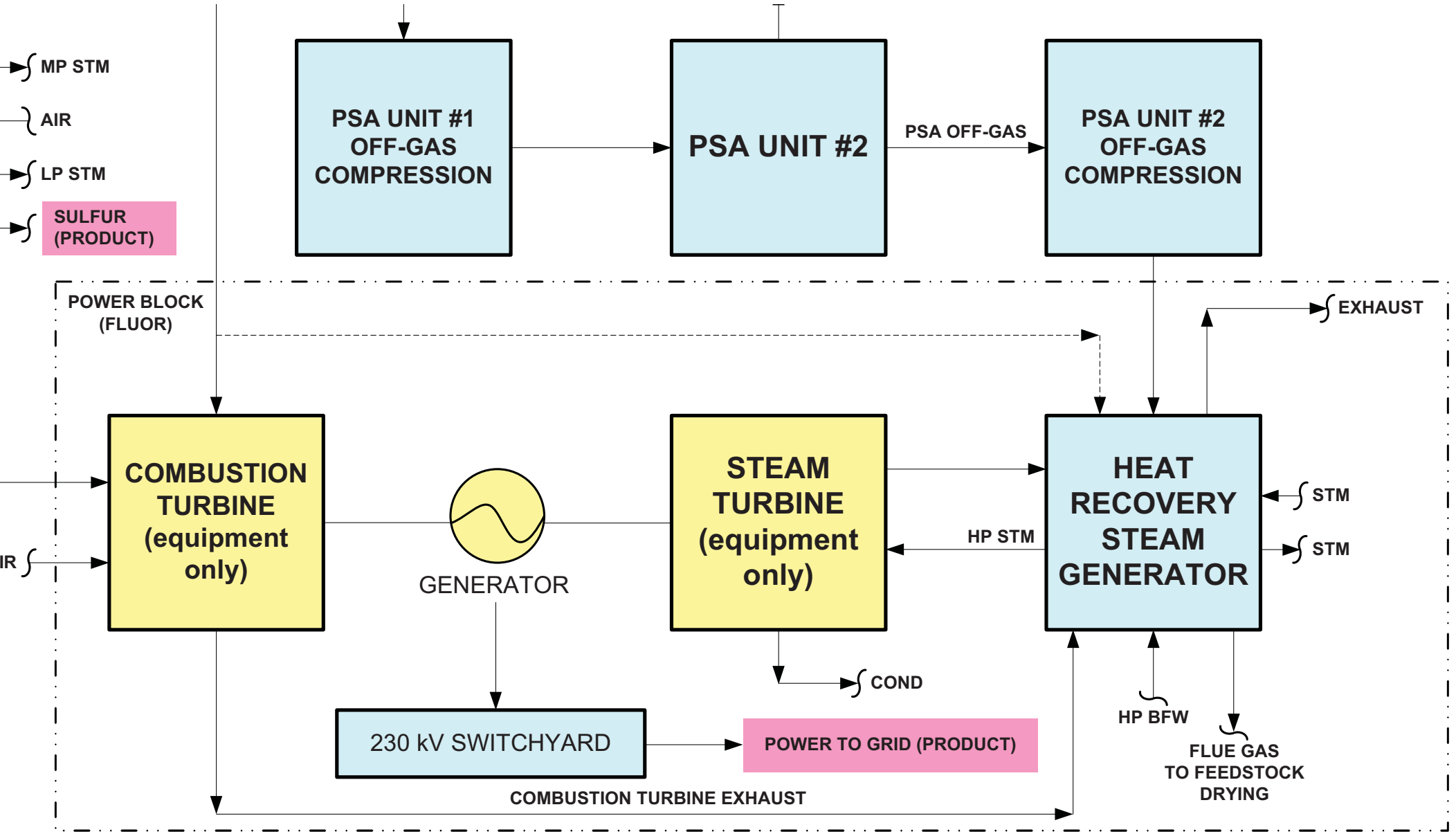
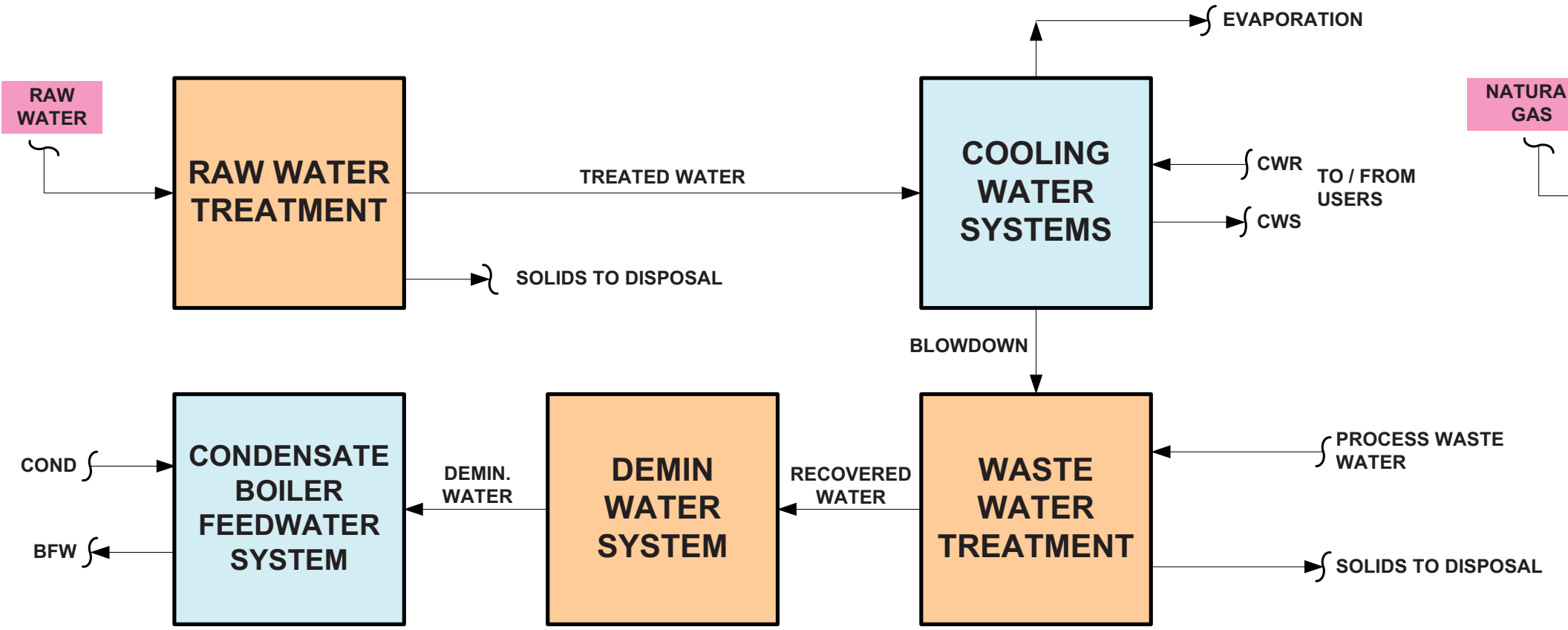
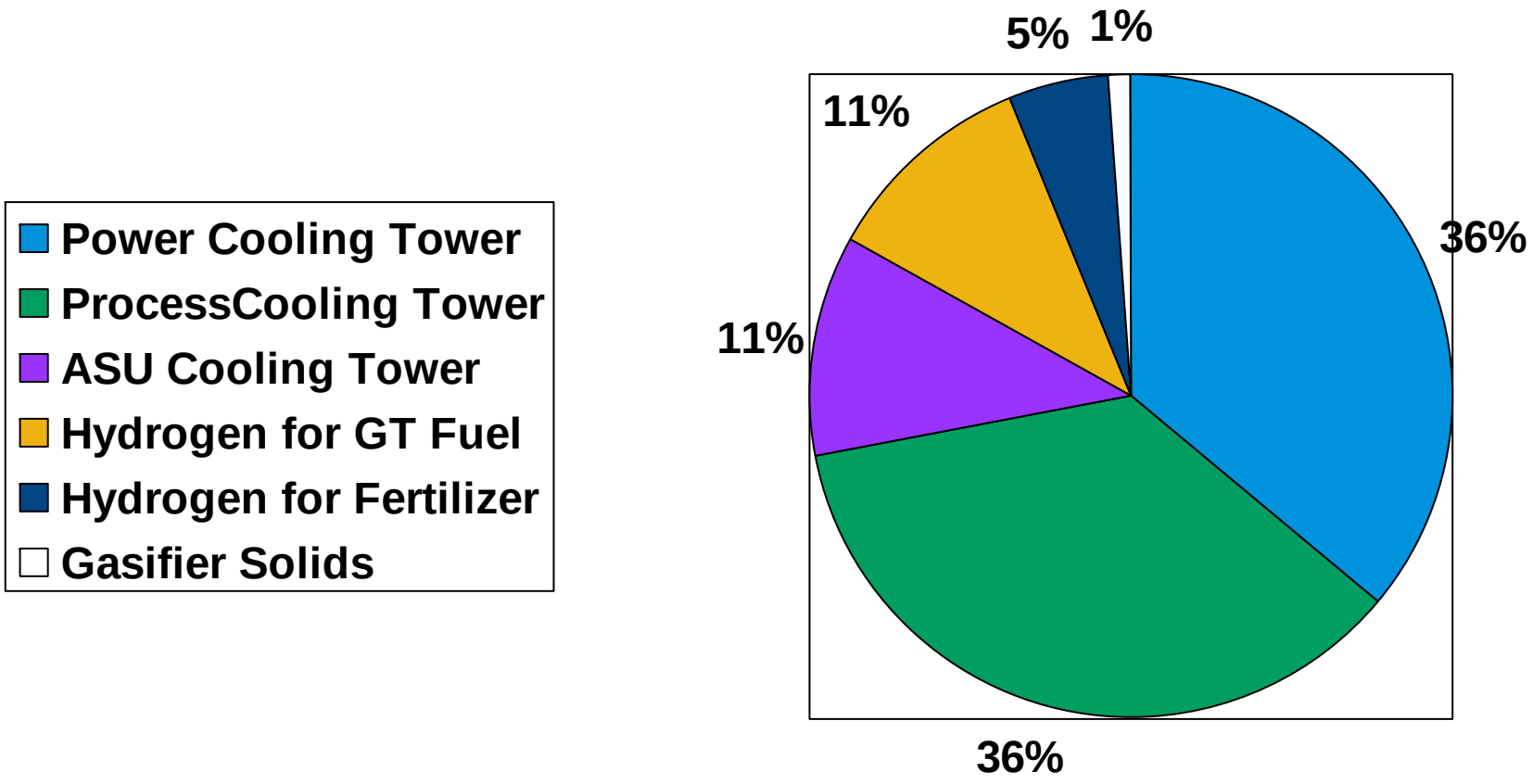
LP STM
PSA OFF-GAS
HP NITROGEN FROM ASU
HP BFW
HP BFW
SRU TAIL GAS
SULFUR RECOVERY UNIT & SULFUR DEGASSING
MP STM
AIR
LP STM
OXIDIZED TAIL GAS (NNF)
SULFUR (PRODUCT)
PSA UNIT #1 OFF-GAS COMPRESSION
PSA UNIT #2
PSA OFF-GAS
PSA UNIT #2 OFF-GAS COMPRESSION


MP STM
AIR
LP STM
SULFUR (PRODUCT)
PSA UNIT #1 OFF-GAS COMPRESSION
PSA UNIT #2
PSA OFF-GAS
PSA UNIT #2 OFF-GAS COMPRESSION
POWER BLOCK (FLUOR)
EXHAUST
COMBUSTION TURBINE (equipment only)
GENERATOR
STEAM TURBINE (equipment only)
HEAT RECOVERY STEAM GENERATOR
HP STM
STM
STM
COND
HP BFW
FLUE GAS TO FEEDSTOCK DRYING
230 kV SWITCHYARD
POWER TO GRID (PRODUCT)
COMBUSTION TURBINE EXHAUST


RAW WATER
RAW WATER TREATMENT
TREATED WATER
SOLIDS TO DISPOSAL
COOLING WATER SYSTEMS
EVAPORATION
CWR
TO / FROM USERS
CWS
NATURA GAS
BLOWDOWN
COND
BFW
CONDENSATE BOILER FEEDWATER SYSTEM
DEMIN. WATER
DEMIN WATER SYSTEM
RECOVERED WATER
WASTE WATER TREATMENT
PROCESS WASTE WATER
SOLIDS TO DISPOSAL

WATER USAGE

Water Usage (% Contribution at 65°F)



Total Water Usage at 65°F: 4,600 GPM

Licensed Process Units

- Gasification - MHI
- Acid Gas Removal – Linde Rectisol
- Ammonia – Ammonia Casale
- Urea – Urea Casale
- Nitric Acid/UAN – Weatherly
- Sulfur Recovery Unit – Fluor Sulfur
- Sulfur Degassing – Goar, Allison & Associates

3-D MODEL AERIAL VIEW

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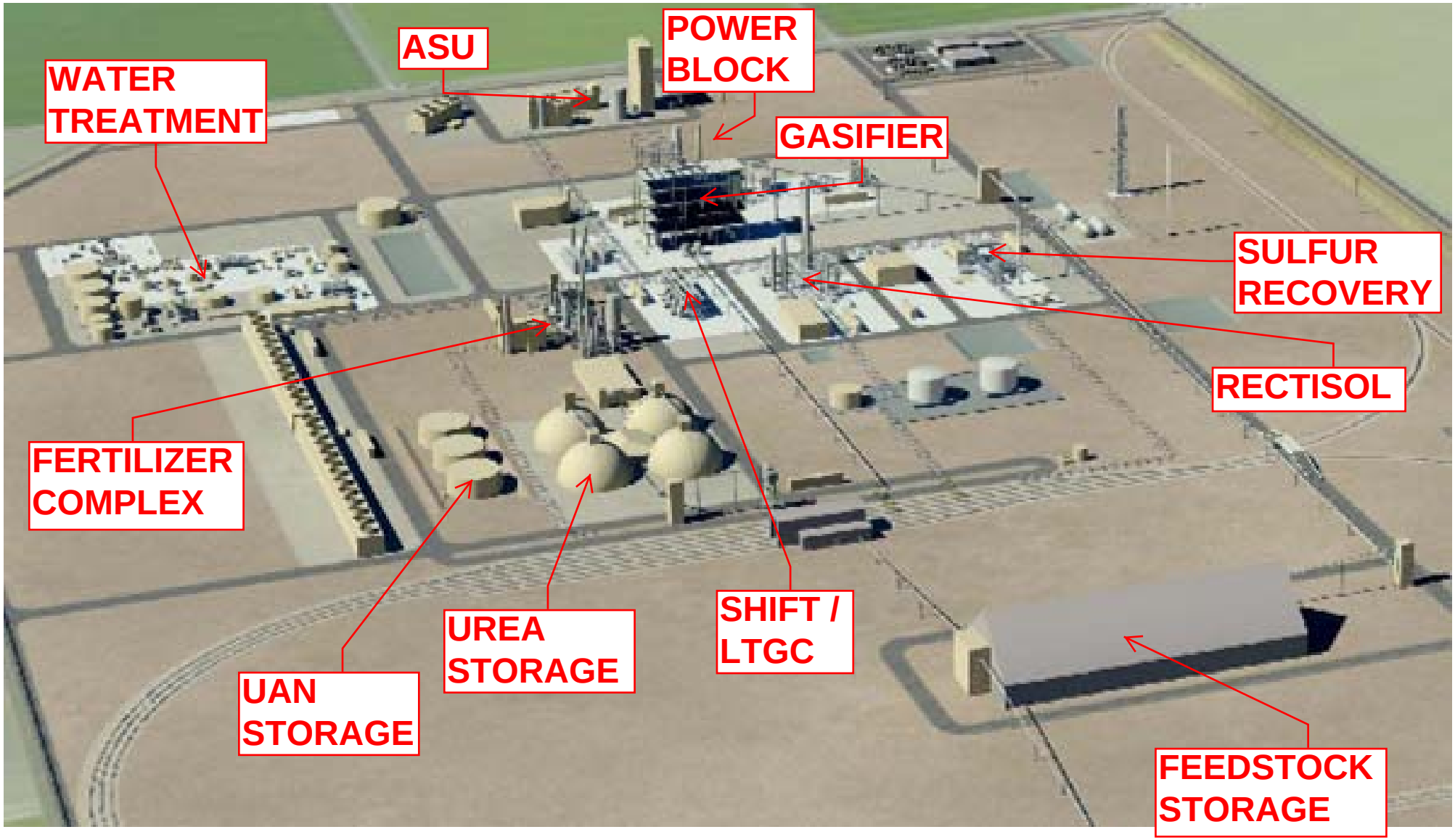

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Path Forward

- The FEED is scheduled to complete on March 31, 2013.
- The permit from the California Energy Commission may be received as soon as May 2013. The permitting process is proceeding as planned.
- The owner desires to close financing and award the EPC contract within a few months of the completion of FEED.
- Debt financing is being sought from the Japan Bank for International Cooperation and capital markets in the USA.
- The Department of Energy will continue to participate in this project as part of the Clean Coal Power Initiative Round 3 (CCPI 3).
- Fluor and MHI will provide Operations & Maintenance services.