Results and estimations of the 5,000 Hour Durability Test at the Nakoso Air Blown IGCC plant (including other activities)

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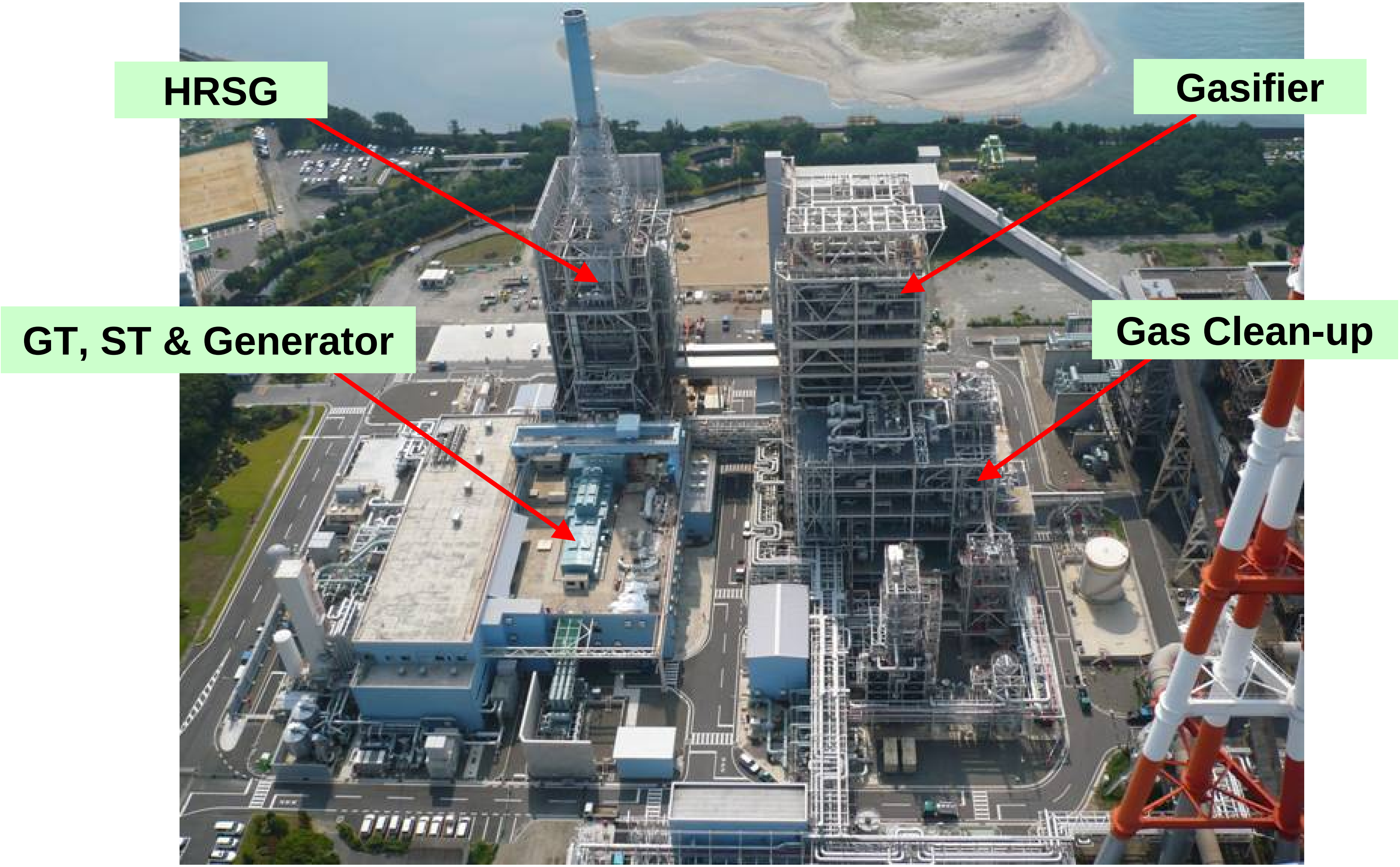
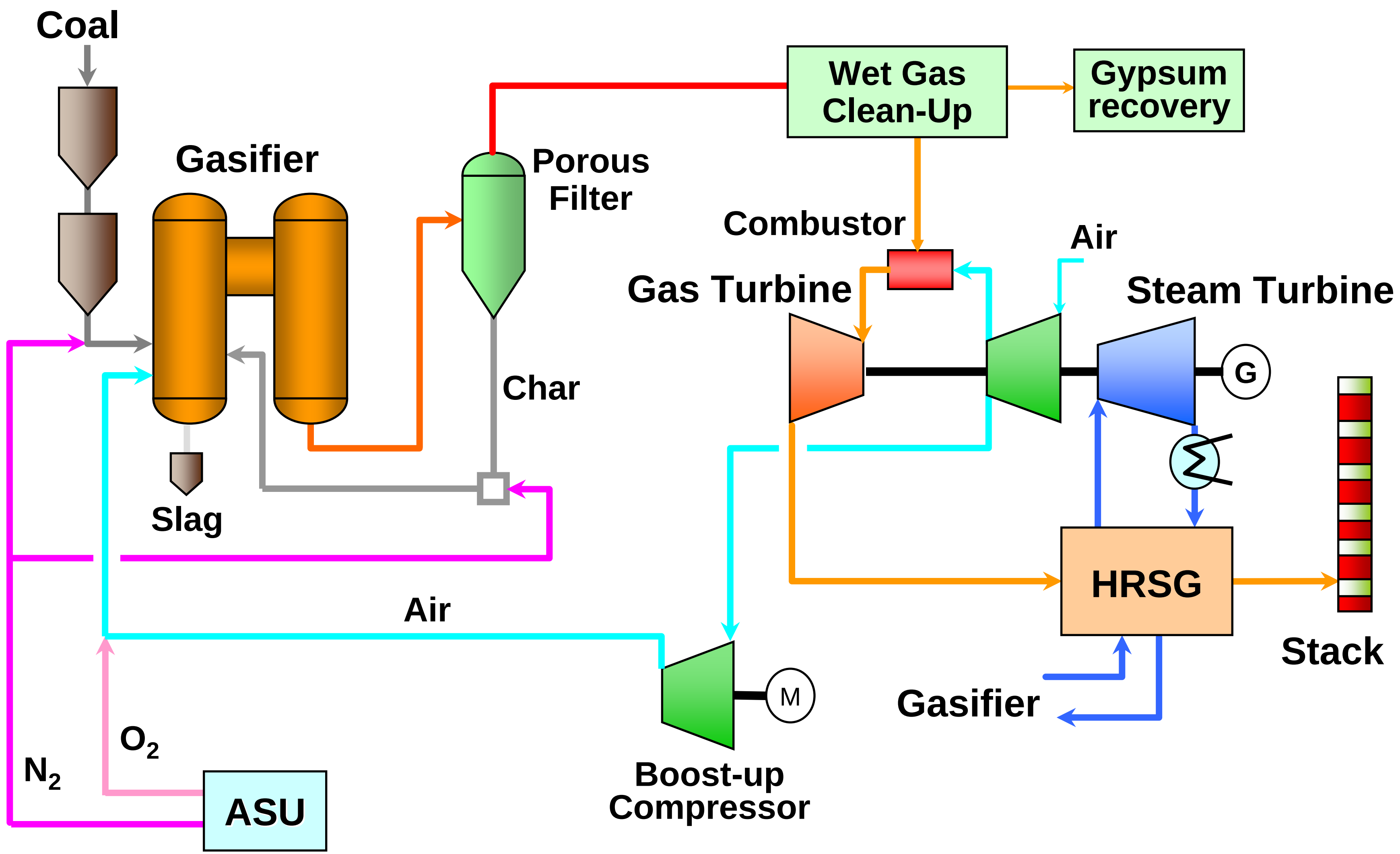
View of IGCC Demonstration Plant



Schematic Diagram of IGCC



(For coal and char transport N_2)

Main Feature of Air-blown IGCC

- Net thermal efficiency is higher than other IGCC designs.
- Carbon conversion rate is more than 99.9%.
- Gasifier design requires no refractory maintenance.
- Operation is to be stable .

Specification of IGCC Demonstration Plant

Capacity	250 MW gross			
Coal Consumption	approx. 1,700 metric t/day			
System	Gasifier	Air-blown & Dry Feed		
	Gas Treatment	Wet (MDEA) + Gypsum Recovery		
	Gas Turbine	2,200 °F-class (50Hz)		
Efficiency (Target Values)	Gross	48% (LHV)	46% (HHV)	
	Net	42.5% (LHV)	40.5% (HHV)	
Flue Gas Properties (Target Values)	SOx	8 ppm		(16% O_2 basis)
	NOx	5 ppm		
	Particulate	4 mg/m^3N		

Status of Targets & Accomplishments

	Target	Past years reported	This year's activity (This presentation)	Future years
Safe and Stable Operation	250MW	250MW	(2)	(3)
Long Term Continuous Operation	>2000hr	2039hr (1568+471hr)		
Net Thermal Efficiency	>42.5% (LHV basis)	42.9%		
Carbon Conversion Rate	>99.9%	>99.9%		
Environmental Performance	SOx <8ppm NOx <5ppm Dust <4mg/m3N	1.0ppm 3.4ppm <0.1mg/m3N		
Coals	Bituminous Sub-bituminous	Chinese, PRB, Indonesian(A)	Indonesian(B), PRB	Expand coal Flexibility
Start-up Time	<18hr	15hr	(1)	
Minimum Load	50%	50%		Lower load test evaluation
Load Change Rate	3%/min	1.2%/min	2.4%/min	Higher load change rate evaluation
Durability & Maintainability	Evaluate during 5000hr test		5013hr(max1948hr)	Maintenance interval evaluation
Economy estimation	Less than or equal to PCF power generation cost		Construction cost and operation cost was estimated. (2)	Maintenance cost evaluation

Main contents of this presentation

(1) Results of 5,000 hour durability test (including the following contents)

- ･Flexibility in coal type test
- ･Load Change rate test

(2) This year's other activity

- ･Additional flexibility in coal type test
- ･Economy estimation

(3) Test plan in the next year and after

(1) Results of 5,000 hour durability test -2

- **Target was accomplished (5,013hr operation) within one year.**

- **Flexibility in coal type test and load change rate test were also conducted during the test period.**

- **Forced outages were experienced in several times due to mainly auxiliary facility incidents in the former period while almost continuous operation were achieved in the latter period.**

- **The causes of the auxiliary facilities incidents were identified and remedy measures were established.**

(1) Results of 5,000 hour durability test -3

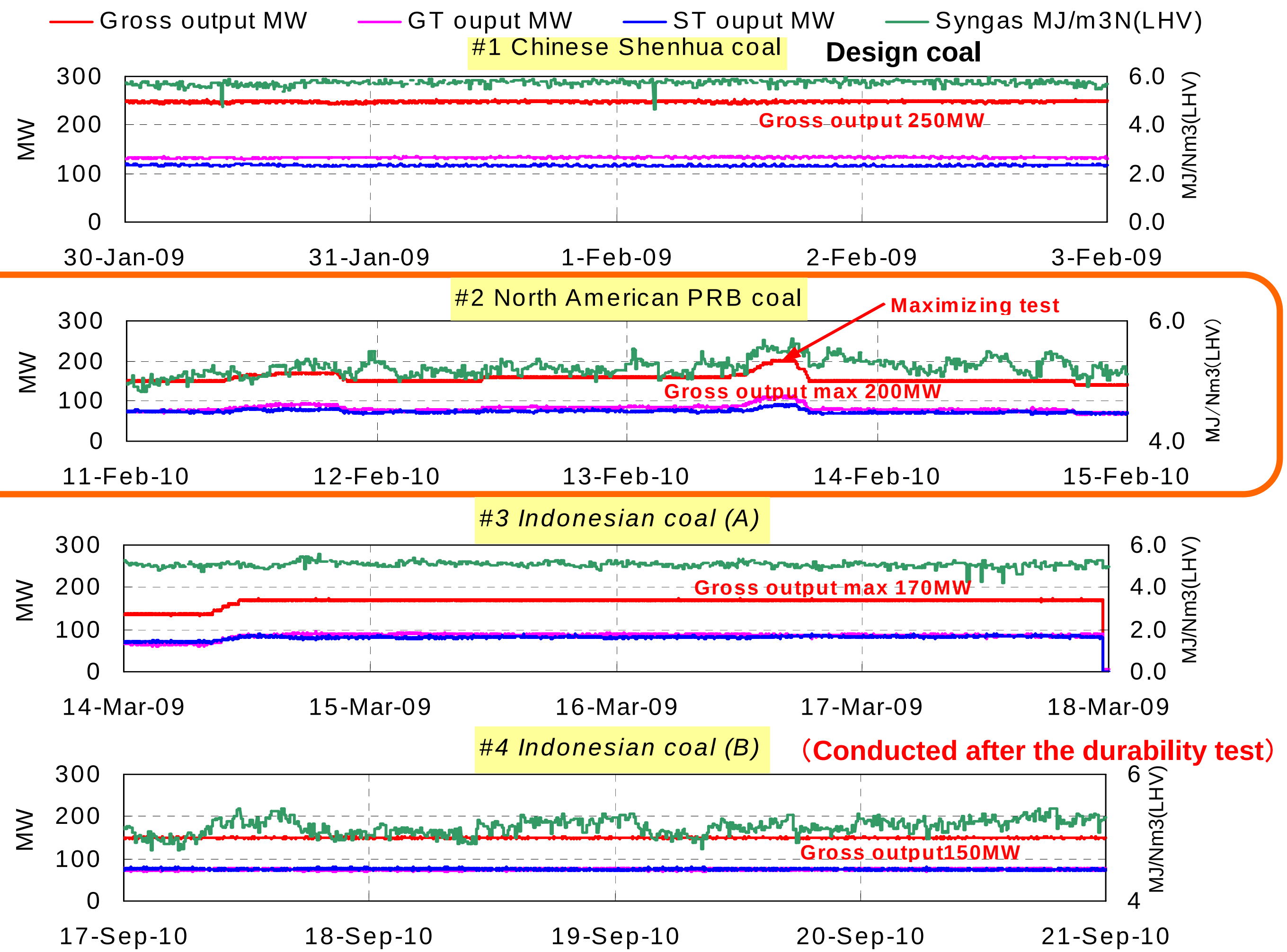
Flexibility in coal type test-1 : Contents of coals

		#1 (Design coal) Chinese Shenhua Coal Jan, 2009	#2 North American PRB coal Feb, 2010	Indonesian Coal	
				#3 (A) Mar, 2009	#4 (B)* Sep, 2010
Gross Calorific Value (air dry)	kJ/kg	27,120	26,670	26,370	23,010
Total Moisture (as received)	wt%	15.4	25.3	21.7	29.7
Total Sulphur (air dry)	wt%	0.25	0.39	0.25	0.12
Proximate Analysis (air dry)					
Inherent Moisture	wt%	7.5	8.0	7.9	17.1
Fixed Carbon	wt%	51.3	47.4	45.2	37.8
Volatile Matter	wt%	32.3	39.1	42.5	41.6
Ash	wt%	8.9	5.5	4.4	3.5
Fusibility of Coal Ash					
Flow Temperature	deg C	1225	1420	1260	1230

（*Conducted after the durability test）

(1) Results of 5,000 hour durability test -4

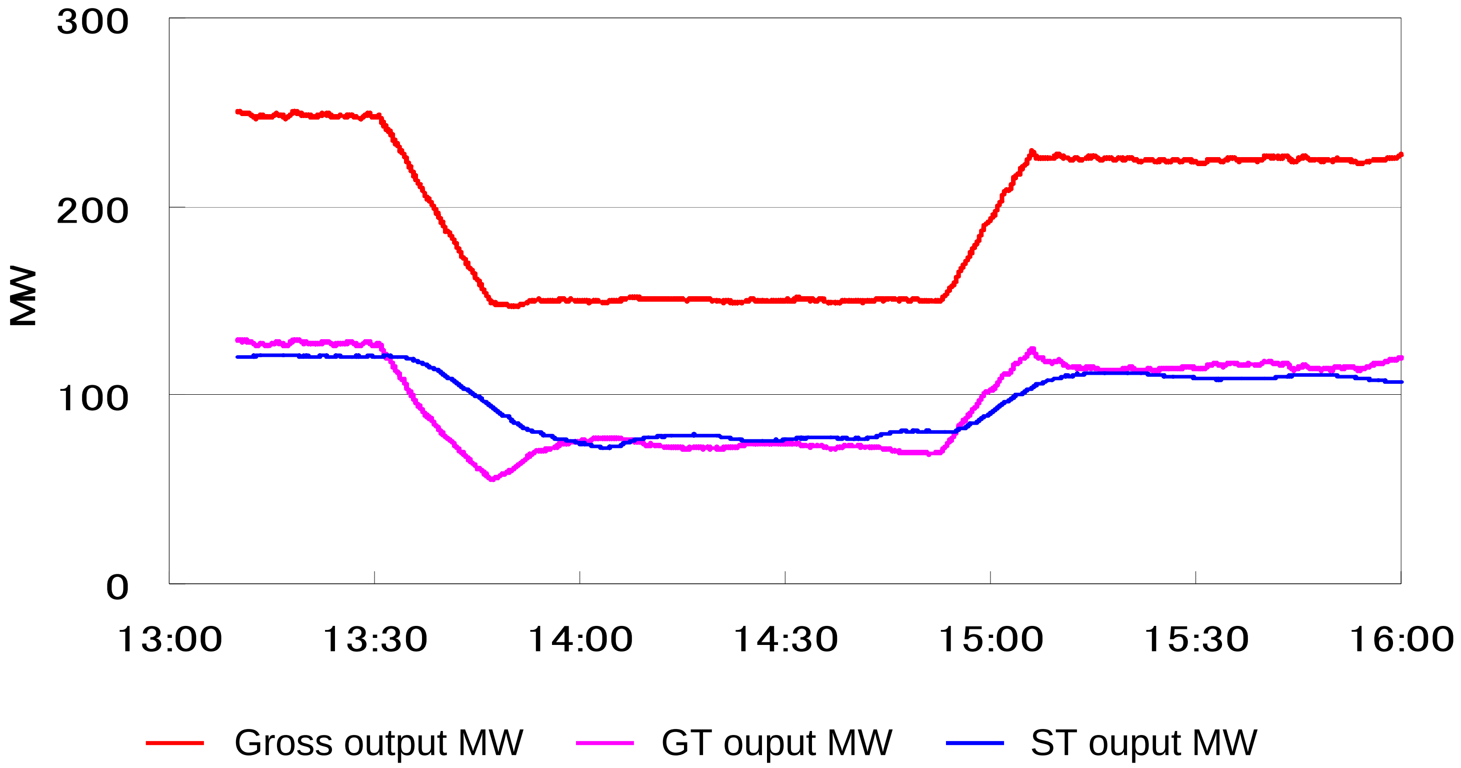
Flexibility in coal type test-2 : Generation output



Stable power generation using various coals was confirmed.

(1) Results of 5,000 hour durability test -5

Load change rate test



・Load Change rate 2.4%/min was confirmed.
・Some adjustment would be required for achieving the target value (3.0%/min).

(1) Results of 5,000 hour durability test -6

Auxiliary facility incident-1

Leakage from Gland of Rotary Valve below Porous Filter

Cause

Inadequate tightening of a packing caused the gas leakage from the gland.

Countermeasure

Proper control of tightening the packing at the gland

(1) Results of 5,000 hour durability test -7

Auxiliary facility incident-2

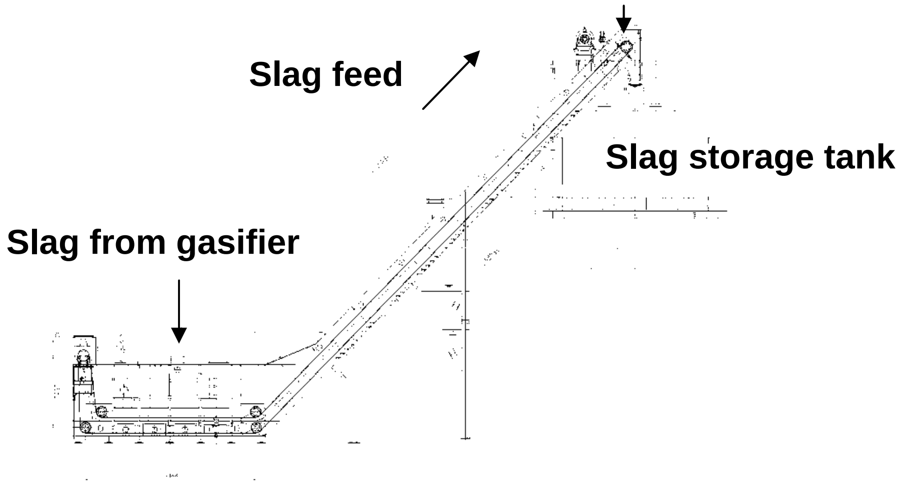
Forced Outage of Slag discharge Conveyor

Cause

Scraper of the drag chain conveyor meandered and stuck onto the gutter of the bottom plate causing overload to the conveyor motor.

Countermeasure

Improvement in the conveyor structure



Slag discharge Conveyor

(1) Results of 5,000 hour durability test -8

Auxiliary facility incident-3

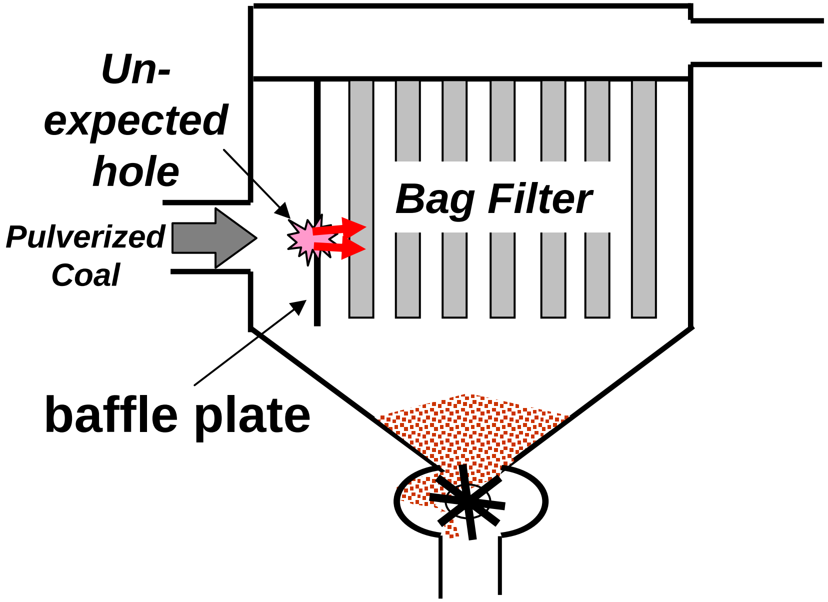
Pulverized coal leakage from bag filter

Cause

A bag filter was damaged to leakage by the unexpected passage of the pulverized coal through the baffle palate.

Countermeasure

The baffle plate was reinforced to withstand the pulverized coal pressure.



(1) Results of 5,000 hour durability test -9

Auxiliary facility incident-4

Leakage of Extraction air Cooler

Cause

Cooler tubes for extraction air were damaged.
Leakage occurred due to the stress corrosion cracking.

Countermeasure

The tube material was changed to titanium.

(1) Results of 5,000 hour durability test -10

Auxiliary facility incident-5

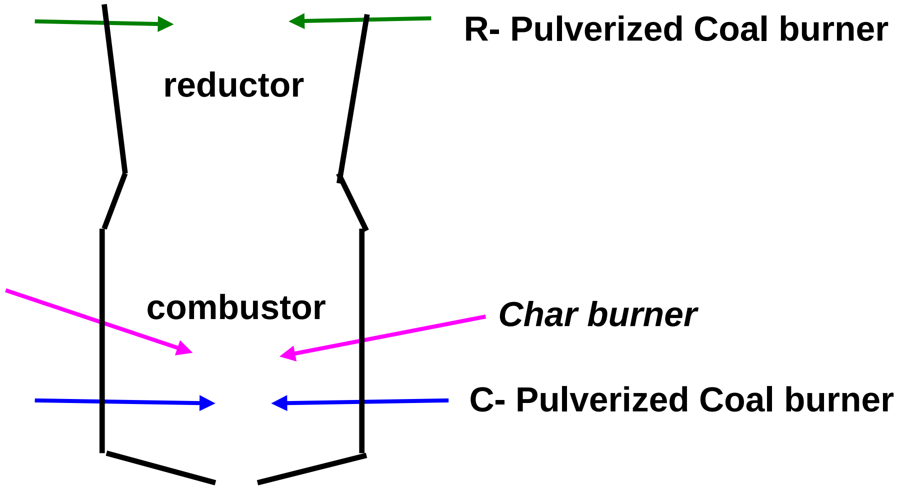
Leakage of Char Gasifier Burner Cooling Tube

Cause

The char accompanied by the secondary air eroded the burner cooling water tube.

Countermeasure

The disposition of the burner was adjusted.



(1) Results of 5,000 hour durability test -14

- Inspection work in June and this fall after the test has been conducted to check the deterioration in the main facility components or functional disorder. No major defects have been observed for the moment

- Overall estimation on the effects to the facilities by the durability test would be summarized and reflected in the reliability as well as economy estimation.

(2) This year's other activity -1

- **Indonesian (B) sub-bituminous coal was tried and the maximum stable load was confirmed in 150MW output.**

- **Stable operation in 90% ASU output was confirmed. Additional lowering ASU output is under investigation to reduce the house power.**

- **Trip happened due to the trouble of the motor for the amine circulation pump.**

(2) This year's other activity -2

Economy estimation

- Construction cost is to be almost 20% higher than conventional PCF at commercial stage.
- Fuel cost could be almost 20% lower than PCF at commercial stage because of higher efficiency.
- Maintenance cost is to be estimated while conducting maintenance work in the plant.
- Next year, we will conduct maintenance outage by law, which would bring about the information for the estimation.
- Cost-reduction in facility is under study such as reducing the components, reflecting the various test results.

(3) Test Plan in the next year and after

- *Improvement in operation*
  - **Additional flexibility test : other types of sub-bituminous coal**
  - **Minimum load test, load change rate test to realize better operation performance**
- *Estimation on reliability and economy*
  - **Validate the effectiveness of the past countermeasure to the facilities**
  - **Economy of commercial IGCC in future reflecting the more realistic maintenance cost**
- *FS with CCS attachment*
  - **Japanese government is performing feasibility study of CCS project, utilizing the Nakoso IGCC. CCP is and will be cooperated with this activity.**

Concluding remark

- CCP is conducting the test in step-by-step approach.

- The result and estimation is almost within our expectation.

- Still, more work should be required.

- In the end, CCP would like to enhance the reliability and maintainability of the air-blown IGCC and finalize the competitive price, complying with the user’s expectation.


Thank you!

Attachment-1

(As of September 30, 2010)

Operating Time	GT Operation by Syngas	9,676 hrs
	Gasifier Operation	9,786 hrs
Power Generation	Cumulative gross output	1,992GWh
Fuel Consumption	Cumulative coal consumption	667 kton (metric)

Attachment-2