9 COGA

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9.1 KEY PROCESS RESPONSIBILITIES

- Monitor and control NOx, CO and O_2 emissions within consent limits
- Monitor and control COGA operation within process control limits
- Request technical assistance through Shift Manager if unable to control within consent limits
- Liaise with Power Station over steam supplies at start-up and shutdown of COGA Unit and significant rate changes
- Liaise with supplying plants (HMD, KA, AA2) over shutdown/start-up of COGA
- Initiate immediate action to correct SOC non-compliance
- Initiate alternative sampling/testing arrangements in accordance with Plant Procedures Manual Section 35 in the event that continuous monitoring equipment fails.

9.2 STANDARD OPERATING CONDITIONS/OPERATING GUIDES
9.2.1 COGA SOC/OG COGA PROCESS CONTROL LIMITS

CONTROL VARIABLE	STANDARD OPERATING RANGE				CONSEQUENCE OF DEVIATION
	LOW	NORMAL	HIGH	UNITS	
Deaerator Level	70	80	90	%	Low – Potential damage to BFW pump High – Potential to overflow Deaerator with hot water
Deaerator Temperature (Local Indication)	100	~ 105		°C	Low – Excessive corrosion of internal Surfaces
Deaerator Pressure	0.6	~ 1.0	1.3	Bar	High – Potential to lift RV (1.72 Bar g)
IP Letdown Deaerator Set Point	0.5	0.5 – 0.6	0.6	Bar	Low – Reduced corrosion protection of Waste heat Boiler
LP Steam to Deaerator (from HMD)	0	6 – 9	10	Te/hr	High – IP Steam wastage
					SOC'S

CONTROL VARIABLE	STANDARD OPERATING RANGE				CONSEQUENCE OF DEVIATION
	LOW	NORMAL	HIGH	UNITS	
Steam Drum Level	45	67	75	%	High – Water in steam main and water hammer Low – Potential damage to Circ Pumps / Evap tubes
Steam Drum Pressure	17.5	18	18.5	Bar	High – Trips burner and potential to lift relief valves Low – Stops export of steam to the main
Steam Export Temperature	208	209	211	°C	
Total Steam Production	25	73	73	Te/hr	Increased Costs
LP Steam to Deaerator (Letdown IP)	0	<2	13	Te/hr	High – Efficiency of Boiler operation as level 'swells' potential to overflow vessel Water hammer in IP steam export main
Steam Drum Level (at start-up only)		60			
Circulation Pumps Discharge Flowrate	400	450 – 465	490	Te/hr	Low – Excessive temperature leading to evaporator tube damage
Circulation Pumps Seal Coolant, DI Water Pressure	0.8	2.5 – 3.0	6.0	Bar	Low – Loss of cooling to seals. Potential catastrophic seal failure.
Circulation Pumps Discharge Flowmeter Differential pressure	180	245	260	m Bar	Low – Could indicate circulation flow is lower than measured.

CONTROL VARIABLE	STANDARD OPERATING RANGE				CONSEQUENCE OF DEVIATION
	LOW	NORMAL	HIGH	UNITS	
HMD Flowrate	250	700 – 1500	2771	Nm^3/hr	Low Flow Trip – Off gas reverts to sending plant. Prevents reverse flow of air into offgas line and formation of flammable mixture in line.
KA Off gas Pressure		0.2 – 0.5		Bar	
KA Flowrate (Reducing Section)	2500	6000 – 18000	25000	Nm^3/hr	Low Flow Trip – Off gas reverts to sending plant
KA Flowrate (Oxidising Section)	500	1000 - 27000	30000		
KA Flowrate (Total)	2500	6000 – 37000	37000		
AA Flowrate	1757	10000 – 15000	19257	Nm^3/hr	Low Flow Trip – Off gas reverts to sending plant
PCA Flowrate	6861		27466	Nm^3/hr	High Flow Trip – Disables burner management system (30000) Low Flow Trip – Trips burner & prevents hot restart
PCA Pressure	0.067		0.079	m Bar	Low Press. Trip – Trips burner & prevents hot restart
OA Flowrate	6870		31271	Nm^3/hr	Low Flow – Switches unit to oxidising mode & trips AA & KA offgas
OA Differential Pressure	43	55 – 60	80	m Bar	Low – Switches unit to oxidising mode & trips KA & AA offgases
(at start-up)		(58-80)		mBar	Low - Prevents purge prior to pilot/main flame ignition

CONTROL VARIABLE	STANDARD OPERATING RANGE				CONSEQUENCE OF DEVIATION
	LOW	NORMAL	HIGH	UNITS	
FGR Flowrate		43000	60000	Nm^3/hr	
FGR Differential Pressure	20	30 – 35	45	m Bar	Low – Switches oxidising section temp control to Oxidising Air. Limits steam production
Reducing Section Temperature					
Oxidising Mode		1200 – 1330	1370	°C	High – Potential refractory damage, trips burner at 1380°C, pre-alarm at 1370°C
Reducing Mode (No off gases)	800	1200 - 1330	1370	°C	
Reducing Mode (AA off gas)	800	1310 – 1330	1370	°C	
Reducing Mode (Only HMD off gas)	800	1310 – 1330	1370	°C	
Reducing Mode (Only HMD & KA off gas)	800	1270	1370	°C	
Reducing Mode (With all off gases)	800	1270	1370	°C	
Quench Water Initiation		1310		°C	
Primary Combustion Air Trim		1350		°C	
Oxidising Section Temperature					
Oxidising Mode		982	1010	°C	High – Potential damage to oxidising Section ceramic lining and boiler Tubes. Trips burner if greater than 1204°C instantaneously or if greater than 1093°C for 1 hour

CONTROL VARIABLE	STANDARD OPERATING RANGE				CONSEQUENCE OF DEVIATION
	LOW	NORMAL	HIGH	UNITS	
Reducing Mode	800	982	1010	°C	
Stack Temperature		125 – 135	175	°C	High – Potential damage to FGR fan
NOx Emission					
Natural Gas Firing		<50	50	mg/Nm^3	High - Potential to exceed environmental limits
Natural Gas & HMD Firing		<50	50	mg/Nm^3	
Natural Gas & KA Firing		100 – 200	1000	mg/Nm^3	Hourly averages above 1000 mg/Nm^3 Have to be reported to EA.
Natural Gas & KA & AA Firing		150 – 400	1000	mg/Nm^3	
CO Emissions					
All firing conditions		<20	50	mg/Nm^3	High – Potential to exceed environmental limits
O_2 Content	3	3	5	%	Low – Incomplete combustion. High CO concentration. Potential to go too fuel rich in Reducing Section and trip on flame out. Get the sending plants to check on fuel content of off gas (eg. VOCs in KA offgas). If not resolved contact Technical. High – Inefficient operation, adjust O_2 trim to reduce stack oxygen. If trim cannot reduce oxygen in stack contact Technical.
Steam Turbine Inlet Pressure	13	14	15	Bar	Potential reduction in water supply to steam drum in emergency

CONTROL VARIABLE	STANDARD OPERATING RANGE				CONSEQUENCE OF DEVIATION
	LOW	NORMAL	HIGH	UNITS	
Steam Turbine Flowrate	3		16.5	m^3/hr	Potential long term damage to unit if steam drum level not maintained (emergency situations only)

9.2.2 COGA SOC/OG – CORRECTIVE ACTIONS

CONTROL VARIABLE	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Low Deaerator Level – Below control limit or loss of/reduced feedwater to deaerator	1. Manual overflow valve open 2. Deaerator level control valve fault 3. Deaerator level control valve not in auto 4. Deaerator level transmitter fault 5. Leaks 6. Low feedwater supply pressure from HMD	1. Deaerator low level alarm will sound	1. Cavitation problems with operational BFW pump 2. Potential damage to both pumps 3. Loss of flow to steam drum, potential to shutdown unit on low steam drum level 4. Potential of Deaerator feedwater inlet nozzles blocking	1. Check Deaerator manual overflow isolation valve closed 2. Check Deaerator level control valve or isolations open 3. Check Deaerator level control not in manual mode 4. Check for leaks 5. Inform Inst. Dept. 6. Check reading on LC95153, LI95154 & LI95155 7. Get HMD to check supply pump operation No 2 hot condy tank level and DI make-up system	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
High Deaerator Level – Above Control Limit	1. Deaerator level transmitter fault 2. Deaerator level control valve not in auto 3. BFW pump suction/delivery valves not fully open	1. Deaerator high level alarm will sound	1. Potentially overflow hot water from Deaerator	1. Check automatic overflow valve functioning correctly 2. Check Deaerator level control not in manual mode 3. Reduce level in vessel by manual overflow if necessary 4. Ensure fire hose supply available to prevent damage to local drains when manually draining Deaerator 5. Check level instrument not isolated 6. Inform Inst. Dept. 7. Check all manual valves are in the correct position	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols

CONTROL VARIABLE	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Low Deaerator Temperature – below Control Limit (this will be seen on local gauge)	1. LP steam valve to the Deaerator closed 2. Receiving cold DI water from HMD	1. Increase in natural gas use 2. Possible decrease in IP steam export	1. Reduced deaeration of boiler feed water 2. Potential increased corrosion of internal surfaces	1. Check with HMD operator hot boiler feed water available 2. Re-instate hot water supply to deaerator 3. If cold water only available from HMD, maintain deaerator temp. with LP steam supply from HMD/steam drum	1. Routine outside patrols 2. Monitor the burner and waste heat boiler DCS screens
High Deaerator Pressure	1. Vent valve fully closed 2. LP steam pressure high or let down PRV faulty or incorrectly set	1. High pressure alarm	1. Potential to trip relief valve (set point @ 1.72 Bar on Deaerator and 1.72/1.59 Bar on IP letdown system)	1. Check LP steam distribution pressure 2. Check LP steam directly lined up from HMD and steam drum export 3. Check set point on PC 95230 (@ 0.6 Bar g)	
IP Letdown Deaerator Set Point	1. Valve incorrectly set 2. Valve failed	1. High pressure alarm	1. Potential for corrosion of waste heat boiler internals 2. If set high then IP steam is wasted by pre warming deaerator feed water 3. Potential to lift relief valves	1. Check IP steam letdown supply to deaerator open 2. Check pressure set point for IP steam let down supply to deaerator 3. Check Nacs/Purge condensate diverted to HMD	

CONTROL VARIABLE	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
High Steam Drum Pressure – Above Control Limit	1. IP steam export valve closed 2. High IP steam main pressure 3. Non return valve fault 4. High steam generation rate	1. Steam drum high pressure alarm will sound	1. Potential to lift steam drum relief valves 2. Potential to trip COGA Unit	1. Ensure export route open 2. Reduce steam generation rate to maintain pressure within control limits. Check IP steam distribution main pressure (via HMD Control Room Operator)	1. Monitor the burner and waste heat boiler DCS screens
Circulation Pumps Discharge Flow Rate Low	1. Pump problem	1. Low flow alarm, low differential pressure alarm	1. Potential damage to evaporator tubes 2. Trips burner	1. Consider pump changeover 2. Contact Technical Resource	
KA Flowrate AA2 Flowrate		1. Low Flow Trip	1. Off gas reverts to sending plant	1. Check with individual operating plants re actual production rates and if operational problems are being experienced 2. Return off gases to COGA if tipped when permissives healthy	
HMD Flowrate		1. Low Flow Trip	1. Off gas reverts to sending plant 2. Potential to create flammable atmosphere in offgas line due to reverse flow of air	1. Check with individual operating plants re actual production rates and if operational problems are being experienced 2. Return off gases to COGA if tipped when permissives healthy	
PCA Flowrate PCA Pressure		1. High Flow Trip	1. Disables burner management system	1. Cross check flowmeter reading on fan suction 2. Check fan operation (noise, vibration etc.)	
OA Flowrate OA Pressure				1. Check fan operation for excess noise/vibration	

CONTROL VARIABLE	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Low Steam Drum Level – Below Control Limit	1. Steam drum level control valve not in auto 2. Steam drum level transmitter fault 3. Manual valves closed on the boiler feedwater line 4. BFW pump fault	1. Steam drum low level alarm will sound	1. Potential damage to operational circulation pump 2. Potential damage to evaporator tubes – significant down time 3. Potential shutdown of unit and HMD/KA/AA plants	1. Check BFW pump operational 2. Ensure steam drum level control not in manual mode 3. Ensure deaerator level control not in manual mode 4. Ensure BFW pump discharge route open 5. Re-establish steam drum level within control limit 6. Ensure emergency feedwater pump raw water supply available at suction of pump	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
Steam Drum Level at Start-up Only			1. As level swells potential to trip on high level	1. Use evaporator drain points to reduce level	
Reduction in IP Steam Export and Increased Use of LP Steam to the Deaerator	1. Receiving cold DI water from HMD 2. Reduced IP steam to the Deaerator isolated 3. Reduced IP steam controller fault 4. Vent valve too far open	1. IP steam export rate will drop	1. Increased cost to site for import of IP steam from Enron 2. Increased costs to site for import of demineralised water from Enron 3. Less efficient boiler operation	1. Check if NACS/Purge and HMD hot condensate available (via HMD Control Room Operator 2. Check Deaerator temperature within control limits (local gauge) 3. Check IP steam letdown supply to Deaerator route open 4. Check pressure set point for IP steam letdown supply to Deaerator 5. Re-establish hot condensate supply to Deaerator (NACS and HMD)	1. Monitor the burner and waste heat boiler DCS screens

CONTROL VARIABLE	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
High Stack Temperature Above Control Limit	1. Economiser bypassed 2. Fault with the FGR fan damper valve 3. Fault on the temperature transmitter 4. Fouling of boiler tubes	1. Stack high temperature alarm will be initiated	1. Potential damage to FGR fan 2. Potential limited operation with OA and PCA air fans only	1. Check route open to economiser with bypass closed 2. Check flue gas control valve FCV 95012 not closed and is functioning correctly – if suspected problem with FCV, shut unit down by normal main flame off and contact technical resource 3. Remove AA offgas – allow unit to stabilise if stack temperature still on increase shut unit down by normal main flame off and contact technical resource 4. If KA offgas on then slowly reduce steam generation rate by 5 tes/hr until stack temperature is within control limits 5. If KA offgas trips (at approx 65 tes/hr steam rate) then continue to monitor stack temperature, if stack temperature increasing shut unit down by normal main flame off contact technical resource 6. If stack temp still above control limit go into oxidising mode when steam rate reduced to 25 tes/hr 7. Inform Instrument Department	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols

CONTROL VARIABLE	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
High NOx, CO emissions – above control limits	1. NOx trim control not in auto with AA offgas on		1. Potentially operate outside environmental consents 2. Potential class A/B/C environmental incident	1. Check the NOx trim is in auto 2. Contact Technical Resource	1. Monitor the burner and waste heat boiler DCS screens
Low O_2 Content	1. High fuel content in off gases 2. Problem with O_2 probes	1. Low stack oxygen alarm will sound	1. High CO in stack gas, potential to operate outside environmental consents 2. Incomplete combustion	1. Check/adjust air trim setting to maintain 3% 2. Contact Technical Resource	

9.3 CONTROL AND MONITORING

PARAMETER	NOTES	EFFECTS
Deaerator Level	Defined as SOC	On low level potential damage to BFW pumps. On high level potential to overflow Deaerator with hot water.
Deaerator Temperature	Local Gauge	Low temperature potential to not effectively deaerate feed water sufficiently resulting in excessive corrosion of internal surfaces.
Deaerator pressure	Vessel Pressure is controlled by LP steam distribution pressure. Defined as SOC	On high pressure potential to lift the Deaerator RV.
IP Letdown to Deaerator Set Point	This is a make-up for the LP steam to the Deaerator should the pressure drop below 0.6 bar.	The make-up of IP steam when required reduces corrosion to the Waste Heat Boiler internals.
Steam Drum Level	At normal steam production rate minimal time of approx 4 mins between high and low levels. Defined as SOC.	On low level potential damage to Circ pumps and to boiler tubes. On high level potential to overflow Steam Drum into steam export system and potential water hammer.
Steam Drum Pressure	Steam drum will be at IP steam distribution pressure. Defined as SOC.	A steam drum pressure below the IP main pressure will stop the export of steam to the main. High pressure could trip burner and cause RV to lift.
Steam Export Temperature	Normal steam export the temperature will be approximately 208°C dependent on the distribution pressure of the works IP main.	
Total Steam Production	FT 95184	
LP Steam to Deaerator	Sum of FT 95183 (from steam drum) and FT 93524 (from HMD) dependent upon feedwater temperature.	Low – incomplete

PARAMETER	NOTES	EFFECTS
Circulation Pumps Discharge Flowrate	Defined as SOC Dependent upon steam generation rate.	On low circulation rates it is possible to damage the evaporator tubes by excessive temperatures.
Circulation Pumps Discharge Flowmeter Differential Pressure	Dependent upon steam generation rate used as cross check on measured flowrate.	See Above.
HMD Flowrate	No control - only a low flow trip	Off gas reverts back to sending plant
KA Flowrate	No control – only a low flow trip	Off gas reverts back to sending plant
AA Flowrate	No control – only a low flow trip	Off gas reverts back to sending plant
PCA Flowrate	Primary combustion air (introduced at burner). Variable flow dependent on steam load and offgas flows. Defined as SOC	
PCA Pressure	Local Gauge Defined as SOC	
OA Flowrate	Oxidising air (introduced after oxidising section with recycled flue gas. Variable flow dependent on steam load and off gas flows.	
OA Pressure	Local gauge	
FGR Flowrate	Flue gas recycle (introduced after oxidising section with oxidising air).	
FGR Pressure	Local gauge.	

PARAMETER	NOTES	EFFECTS
<u>NOx Emissions</u>		
Natural Gas Firing	Defined as SOC – If outside range technical assistance required.	Potential to exceed Environmental Limits
Natural Gas and HMD Firing	Defined as SOC – If outside range technical assistance required.	Potential to exceed Environmental Limits
Natural Gas & HMD & KA Firing	Defined as SOC – If outside range technical assistance required.	Potential to exceed Environmental Limits
Natural Gas & HMD & KA & AA Firing	Defined as SOC – If outside range technical assistance required.	Potential to exceed Environmental Limits
<u>CO Emissions</u>		
All firing conditions	If outside range technical assistance required.	Potential to exceed Environmental Limits
<u>Offgases to Unit</u>		
HMD Offgas	1. If offgas not introduced to unit then specific reason must be recorded. 2. SETCIM will record duration that offgas on/off to unit	
KA Offgas	1. If offgas not introduced to unit then specific reason must be recorded 2. SETCIM will record duration that offgas on/off to unit	
AA Offgas	1. If offgas not introduced to unit then specific reason must be recorded 2. SETCIM will record duration that offgas on/off to unit	

PARAMETER	NOTES	EFFECTS
Steam Turbine Inlet Pressure	This pump would only be used in an emergency situation (see Operating Instructions).	Potential reduction in water supply to steam drum in emergency.
Steam Turbine Flowrate	This pump will be used to maintain steam level in emergency situation only.	Potential long term damage to unit if steam drum level not maintained.

9.4 ABNORMAL RUNNING FAULT DIAGNOSIS

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Loss of Instrument Air (to LCV 95153 & LCV 95166)	1. Instrument failure	1. Valves will go to failure positions ie. Open	1. Potential to overfill Deaerator, Steam Drum and Steam Export Main	1. Monitor Deaerator and Steam Drum levels, maintain within control limits by manual isolation valves around LCV 95153 and LCV 95166 2. Inform Instrument Department	1. Monitor the burner and waste heat boiler DCS screens
Cannot Start Primary combustion Air Fan	1. Fan permissives not healthy 2. Fan tripped or fuses removed/isolated 3. Too many fan starts in half an hour	1. Fan won't start	1. Unable to light the burner	1. Ensure fan permissives healthy 2. Ensure fan requested to start from DCS 3. Ensure motor cool down period elapsed 4. Ensure that the fan has not been started twice within last half hour	1. Monitor the burner and waste heat boiler DCS screens 2. Only start the fan twice in half an hour
Cannot Establish Pilot Flame	1. Francel valve fault 2. Flame detector fault 3. Pilot gas manual valves isolated 4. Pilot 'slam shut valve' requires resetting	1. No flame detected and UV scanners	1. Unable to light the burner	1. Reset the Francel valve if tripped 2. Check all manual valves are in the correct position 3. Contact Technical Resource after 3 attempts	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Cannot Start Flue Gas Recycle Fan	1. Fan permissives not healthy 2. Fan tripped or fuses removed/isolated 3. Too many fan starts in half an hour 4. PCA fan not running	1. Fan won't start	1. Unable to go reducing	1. Ensure primary combustion air fan running 2. Ensure remaining flue gas recycle fan permissives healthy 3. Ensure motor cool down period elapsed 4. Ensure that the fan has not been started twice within last half hour	1. Monitor the burner and waste heat boiler DCS screens 2. Only start the fan twice in half an hour
Cannot Start Oxidising Air Fan	1. Fan permissives not healthy 2. Fan tripped or fuses removed/isolated 3. Too many fan starts in half an hour 4. PCA fan not running	1. Fan won't start	1. Unable to go reducing	1. Ensure primary combustion air fan running 2. Ensure remaining oxidising air fan permissives healthy 3. Ensure motor cool down period elapsed 4. Ensure that the fan has not been started twice within the last half hour	1. Monitor the burner and waste heat boiler DCS screens 2. Only start the fan twice in half an hour
Cannot Establish Main Flame	1. Francel valve fault 2. Natural gas manual valves isolated 3. Main flame 'slam shut valve' requires resetting	1. No flame detected and burner tripped	1. Unable to light the burner	1. Reset the Francel valve if tripped 2. Check all manual valves are in the correct position 3. Contact Technical Resource after three attempts	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Cannot Introduce HMD Offgas	1. Check all relevant permissives are healthy 2. Block valve fault 3. HMD offgas manual valves closed	1. Low gas flow trip will be initiated	1. Increased usage of natural gas fuel to burner	1. Attempted to introduce gas too early after last offgas – wait correct interval and try again 2. Check permissives healthy 3. Check all manual valves are open 4. Contact Technical Resource after 3 attempts	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
Cannot Introduce AA Offgas	1. Check all relevant permissives are healthy 2. Block valve fault 3. AA offgas manual valves closed	1. Low gas flow trip will be initiated	1. Potentially exceed EA consent diverting AA to local stack for excessive duration	1. Attempted to introduce gas too early after last offgas – wait correct interval and try again 2. Ensure operating reducing conditions 3. Ensure chamber temperatures >900°C 4. Check permissives healthy 5. Check all manual valves are open 6. Contact Technical Resource after 3 attempts	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Cannot Introduce KA Offgas	1. Check all relevant permissives are healthy 2. Block valve fault 3. KA offgas manual valves closed	1. Low gas flow trip will be initiated	1. Potentially exceed EA consent diverting KA to local stack for excessive duration	1. Attempted to introduce gas too early after last offgas – wait correct interval and try again 2. Ensure chamber temperatures >900 3. Check permissives healthy 4. Check all manual valves are open 5. Ensure operating in reducing mode 6. Contact Technical Resource after 3 attempts	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
Cannot go Reducing/Maintain Reducing Conditions	1. Check all relevant permissives are healthy 2. Reducing temperature <800°C 3. Oxidisers temperature <800°C 4. Temperature ramp in operation	1. Oxidising conditions will be reinstated if reducing 2. Unable to go reducing	1. AA offgas will trip 2. Potentially exceed EA consent diverting AA to local stack for excessive duration	1. Attempted to go reducing too early after last offgas – wait correct interval and try again 2. Ensure chamber temperatures >900°C prior to attempting to go reducing 3. Ensure chamber temperatures >800°C when in reducing mode 4. Check all permissives and interlocks healthy 5. Contact Technical Resource after 3 attempts	1. Monitor the burner and waste heat boiler DCS screens
Natural Gas Pressure Regulating Valves Fail to Control Gas Pressure to Pilot and Main Burner	1. Fault on the Francel valve 2. Loss of Enron supply	1. Low natural gas pressure trip 2. Pressure control valve repeatedly opening/closing	1. Possible repeated unit shutdown on low/high gas pressure	1. Inform DuPont technical 2. Check with HMD/Services for loss of Enron natural gas supply to Nylon	1. Monitor the burner and waste heat boiler DCS screens

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Thermocouple Failure on Reducing/Oxidising Section	1. Electrical fault 2. Thermocouple burnt out	1. The failed thermocouple will read high/low	1. Unit will continue to operate if one thermocouple fails in each section 2. If two thermocouples in one section fail the unit will shutdown	1. If single thermocouple failure do not shutdown unit – inform DuPont technical 2. If two thermocouples (one on reducing and one on oxidising) fail, then start temperature ramp down to shutdown unit (via DuPont technical) 3. If two thermocouples (both on reducing or both on oxidising fail, then unit will immediately shutdown without temperature ramp	1. Monitor the burner and waste heat boiler DCS screens
UV Detector Failure	1. Manually isolated 2. Electrical fault	1. The UV detector will read high/low	1. If both UV detectors fail then unit will immediately shutdown	1. Check manual isolations 2. If single UV detector failure, do not shutdown unit – inform DuPont technical	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
Spark Ignitor Fails to Light Pilot	1. Electrical fault	1. No feedback to UV flame detectors 2. No visible flame from sight glass	1. Cannot light pilot burner	1. Shutdown unit 2. Inform DuPont technical	1. Monitor the burner and waste heat boiler DCS screens

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Pump Strainer Blocked	1. Foreign material from the Deaerator/Steam Drum	1. Low delivery pressure	1. Sudden start of standby pump 2. Cavitation problems in running pump	1. If single circ pump strainer blocked then continue operation 2. If single BFW pump and the emergency turbine pump is not available then start temperature ramp down to shutdown unit (via DuPont technical)	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
Natural Gas Filter Blocked	1. Foreign material from the natural gas main	1. Potential low gas pressure to pilot or main burner 2. Natural gas pressure control valve will be fully open	1. Burner main rip on low natural gas pressure	1. Monitor gas pressure and start temperature ramp down to shutdown unit if approaching natural gas low pressure trip 2. Unit will immediately shutdown on low gas pressure	1. Monitor the burner and waste heat boiler DCS screens
Loss of Gas Supply	1. Problem with the Enron gas main	1. Low natural gas pressure	1. Unit will immediately shutdown	1. Contact the HMD Shift Manager 2. See Operating Instructions	1. Monitor the burner and waste heat boiler DCS screens
Leak of Natural Gas	1. Mechanical failure	1. Natural gas flow control valve % open increased	1. Potential explosive gas cloud release	1. Start temperature ramp down to shutdown unit (via DuPont technical) 2. If significant leak immediately shutdown the unit	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Leak of Water	1. Mechanical failure	1. Deaerator level control valve % open increased	1. Increased use of DI water	1. Evaluate leakage (via DuPont technical or FLM/SO)	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
Leak of Offgas (HMD, KA, AA)	1. Mechanical failure	1. Possible low off gas flow trip 2. Possible fume visible from leak	1. Potential gas cloud release	1. Evaluate leakage (via DuPont technical or FLM/SO) 2. If significant leak immediately shutdown the relevant offgas to the unit	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
BFW Pump Failure	1. Mechanical failure	1. Will not be able to maintain the steam drum level 2. Low pump delivery flow 3. Standby pump will start	1. Loss of steam drum water supply 2. Potential long term damage to unit	1. If single BFW pump and the emergency turbine is not available then start temperature ramp down to shutdown unit (via DuPont technical) 2. If both BFW pumps fail start up the emergency boiler feedwater pump	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols

FAULT	CAUSE	APPEARANCE	EFFECT	CORRECTIVE ACTION	PREVENTION
Standby Circulation or BFW Pump Started	1. BFW pump low delivery pressure 2. Boiler Circ pump low flow 3. Pump filter choked 4. Pump failure	1. Standby pump should have started	1. Possible increase in BFW pump delivery pressure 2. Possible increase in boiler circ pump flow	1. Check which interlock started the standby pump 2. Check suction pressure of both pumps BFW pump should read >0.6 bar, circ pump should read approx 20-21 bar. 3. If low suction pressure suspect arrange for filter clean 4. If low flow on circ pumps suspect problems with operation of the non-return valve on discharge side of pump, contact DuPont technical	1. Monitor the burner and waste heat boiler DCS screens 2. Routine outside patrols
Loss of HMD Condensate Pump (via HMD Control Room Operator)	1. Mechanical failure	1. Will not be able to maintain the Deaerator level	1. Loss of steam drum water supply 2. Potential long term damage to unit	1. If only a single HMD condensate pump is available then start temperature ramp down to shutdown unit (via DuPont technical) 2. If both condensate pumps fail start up the emergency boiler feedwater pump	1. Monitor the burner and waste heat boiler DCS screens

9.5 TRIPS / ALARMS / DCS LOGIC

9.6 RELIEF VALVE SETTINGS

DESCRIPTION	RELIEF VALVE Nos	SET PRESSURE
Deaerator Relief Valve	RV 9938	1.72 Bar g
Economiser Relief Valve	RV 9943	25 Bar g
Steam Drum Relief Valve	RV 9939	21.5 Bar g
Steam Drum Relief Valve	RV 9941	22.5 Bar g
Flash Vessel Relief Valve	RV 9865	14 Bar g
IP/LP Letdown Relief Valve (for Deaerator)	RV 9948	1.724 Bar g
LP Steam Supply	RV 9951	1.59 Bar g
Pilot Gas Relief Valve	RV 9936	1.4 Bar b
Pilot Gas Over Pressure Valve	OPV 95102	2.6 Bar g
Main Gas Relief Valve	RV 9937	1.4 Bar g
Main Gas Over Pressure Valve	OPV 95109	3.0 Bar g

STANDARD OPERATING CONDITIONS & OPERATIONAL GUIDELINES
(SOC/OG)

TITLE: Weak Liquor Pumps Circulation Pressure (5111/111&112)

TAG NUMBERS	LOW TRIP	LOW ALARM	NORMAL OPERATING RANGE	HIGH ALARM	HIGH TRIP	UNIT
PAL33057		2.5				barg
DCS/HIMA TRIP/ALARM CLASS						

REASON FOR SOC/OG

To warn of low Circulation pressure and to prevent Low Flow/No Flow to the HP/LP Absorbers and Vent Scrubber

Low Alarm – 2.5 barg has been set to warn of pump problems, which could cause a lack of flow. The alarm has been set based on an estimated delivery pressure of 3.5 to 4 barg. A lack of flow to the HP Absorbers should cause 5101/169A&B to take cold condy feed from 5101/161 Head Tank. Weak Liquor flow would stop to the LP Guard Absorber and a low weak liquor flow to the Vent Scrubber would trip open the cold condy nozzle.

CORRECTIVE ACTIONS TO CONTROL WITHIN NORMAL OPERATING RANGE

Check Pump and local delivery pressure gauge and change over if necessary
Check Condy supply to the Absorbers and Vent Scrubber system
Check there is a normal level in the Weak Liquor Tank

CONSEQUENCES OF TRIP BYPASS/FAILURE

Damage to the Pumps
Loss of weak liquor flow and absorption in the HP/LP Absorbers resulting in High Ammonia Concentrations to COGA/Stack and atmosphere leading to a possible Environmental Incident

STANDARD OPERATING CONDITIONS & OPERATIONAL GUIDELINES
(SOC/OG)

TITLE: Vent Scrubber Weak Liquor Flow (5111/119)

TAG NUMBERS	LOW TRIP	LOW ALARM	NORMAL OPERATING RANGE	HIGH ALARM	HIGH TRIP	UNIT
FALL33067	3	4	6 – 7			Tes
DCS/HIMA TRIP/ALARM CLASS	DCS E					

REASON FOR SOC/OG

To warn of, and prevent low weak liquor flow to the Vent Scrubber preventing high emissions of Ammonia to atmosphere from the 20% Tanks via the Vent Scrubber.

Low Alarm – 4 Tes has been set to give a warning that the low trip is being approached and that scrubbing efficiency in the Vent Scrubber may be reduced. No data was available on the weak liquor nozzle in 5111/119 Vent Scrubber so this setting has been estimated based on flowrates measured before this project.
Low Trip – 3 Tes has been set to trip open the cold condensate flow on a separate nozzle in the Vent Scrubber. However the details of the cold condy nozzle were also unknown so this flow is governed by ROP33068. Continued condy flow will increase the level in 5111/110 Weak Liquor tank and step may have to be taken to keep its level under control.

The alarm & trip settings may have to be increased if it is found that a nuisance level of ammonia can be detected leaving the Vent Scrubber. A low flow could indicate that either or both of the weak liquor spray nozzles in 5111/119 are blocked. Each spray nozzle has two internal holes approx. 5mmx8mm.

CORRECTIVE ACTIONS TO CONTROL WITHIN NORMAL OPERATING RANGE

Check the Weak Liquor Pumps and delivery pressure
Check operation of FV33067
Check Condy Trip on the Vent Scrubber is operating, if required
Check Condy flows and control valves to the HP/LP Absorbers

CONSEQUENCES OF TRIP BYPASS/FAILURE

Emission of Ammonia vapours to atmosphere from the Vent Scrubber leading to a possible Environmental Incident

HMD SYNTHESIS

STANDARD OPERATING CONDITIONS & OPERATIONAL GUIDELINES
(SOC/OG)

TITLE: Ammonia Column Pressure (5111/113)

TAG NUMBERS	LOW TRIP	LOW ALARM	NORMAL OPERATING RANGE	HIGH ALARM	HIGH TRIP	UNIT
PAHH33134 PZAHH33162 (HIMA)			12 – 13 (HO 13.5)	13.8 13.8	15.5 15.5	barg barg
DCS/HIMA TRIP/ALARM CLASS					DCS/ HIMA B	

REASON FOR SOC/OG

To warn of High Pressure in the Column and prevent the relief valve sending a release to Stack.

Deviation Alarm – at 1.0 bar between the two transmitters, have both check calibrated if the alarm occurs.
High Override – 13.5 barg is set to occur before the high alarm. The override controller acts to reduce the 20% Feed to the column.
High Alarm – 13.8 barg warns that the high trip is approaching. If the column is being operated at high temperatures because of high cooling water temperature then the feed and reflux rate of the column should be controlled so that PV33134-1,2,3 stay within their operating range. There should be similar monitoring of the reboiler steam flow control valve to check that a reboiler limitation is not reached. This setting is related to the setting of PI33139 and the RV set pressure of the CW side thermal relief valves on 5111/134 and 5111/140.
High Trip – 15.5 barg is set avoid the chance of any reverse flow from the column back up the IP Steam main, should direct steam injection be used on the column. This setting also gives a margin over the RV set pressure, which allows for the pressure surge that occurs when liquid NH3 from the top of the column dumps and revaporises when it hits the hot water in the base of the column. This margin between the trip and RV setting would be important if the high pressure was caused by a lack of condensing capacity.

CORRECTIVE ACTIONS TO CONTROL WITHIN NORMAL OPERATING RANGE

Check Override controller in Automatic
Check operation of the Condenser Cooling Water Valves and reflux ratio
Check Cooling water Temperature and Pressure
Reduce Steam flow and 20% feed flow, where Column conditions allow

CONSEQUENCES OF TRIP BYPASS/FAILURE

Relief Valve lifts at 19.31 barg causing Ammonia release to Stack causing a possible Environmental Incident

HMD SYNTHESIS

STANDARD OPERATING CONDITIONS & OPERATIONAL GUIDELINES
(SOC/OG)

TITLE: Ammonia Column Side Stream Flow (5111/113)

TAG NUMBERS	LOW TRIP	LOW ALARM	NORMAL OPERATING RANGE	HIGH ALARM	HIGH TRIP	UNIT
FAH33136				150		Kg/hr
DCS/HIMA TRIP/ALARM CLASS						

REASON FOR SOC/OG

To warn of High Purge flowrate

High Alarm – 150 kg/hr was set during commissioning as the highest purge flow required to keep the desired temperature profile in the middle of the column, by avoiding organic build-up. This purge rates assumes the worst levels of each individual organic component from analysis of 20% NH3 solution. If the purge rate is set too high this would mean a high NH3 loss to COGA or the Synthesis Stack, which is undesirable for the environment and variable cost performance.

CORRECTIVE ACTIONS TO CONTROL WITHIN NORMAL OPERATING RANGE

Adjust FC33136
Adjust Manual valves on the Column to change the ratio of the flows from each purge point.
Check that the column temperature profile looks normal

CONSEQUENCES OF TRIP BYPASS/FAILURE

High Ammonia concentration to COGA or the Synthesis Stack