HAZARD IDENTIFICATION AND RISKASSESSMENT IN BOILER

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ABSTRACT

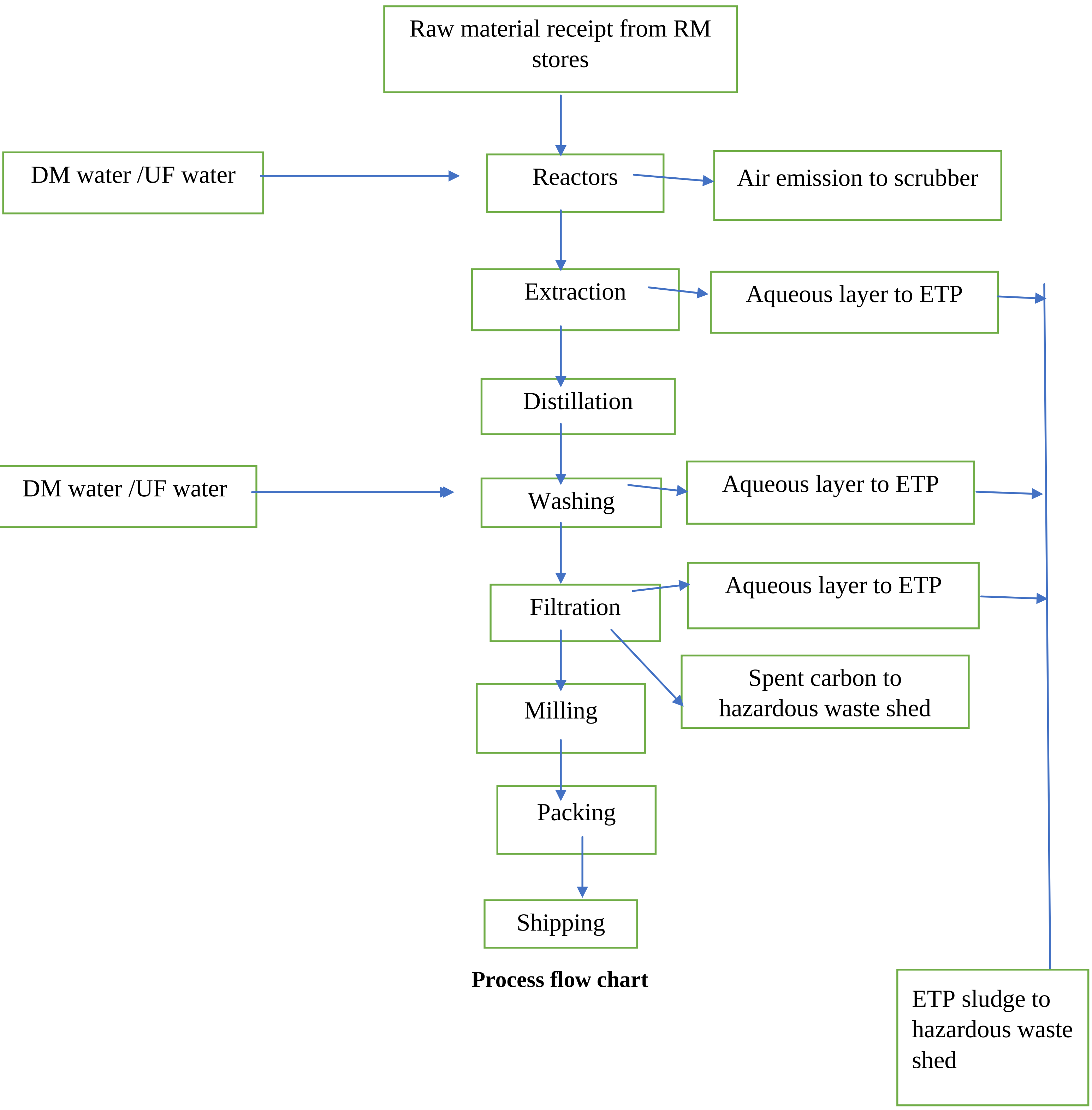
Work place a central role in people's lives since most worker spend at least eight hour a day in the work place, whether it is on a plantation in an office, factory etc. Work environment should be safe and health. Occupational health issues are often given less attention than occupational safety issues because the former are generally more difficult to confront. The important point is the issues of both health and safety must be addressed in every work place. In this project operational mechanical and human factors are to be are to be considered in safety management system to avoid accident. Study of various accident during reasoning days. Prevention will be main scope for accidents in various industries. Since more methodology has been desired for the critical process like (equipment, boiler compress reactors power equipment) and operating procedure, handling of boiler.

CHAPTER -1
INTRODUCTION

1.1 COMPANY PROFILE:

- Solara Active Pharma Sciences limited is the leading API manufacturing company, located in Cuddalore. It was commissioned in the year, 1994.
- It manufactures Active Pharmaceutical Ingredients (APIs), their intermediates and enteric coating excipients with a significant presence in some key generics.
- Solara has created a strong product portfolio, building on its R & D. Expertise, regulatory capabilities and large scale production capacities.
- Solara has also emerged as a key player in various service segments in the field besides APIs and intermediaries, and is strengthening its offer of contract research, custom synthesis and contract manufacturing services to clients.
- Solara is a Public Limited Company. It is one of the largest producers of Ibuprofen worldwide. The company offers derivatives of Ibuprofen like Ibuprofen Sodium, Ibuprofen Lysinate and Ibuprofen.
- It is also one of the major producers of Gabapentin,Ranitidine and Nizatidine in the world. The company enjoys leadership status in the anti-inflammatory and anti-ulcerative segments.
- Solara is ranked as a major exporter from India. Its products are exported to more than 40 countries across North America, Europe, Asia and Latin America.

PROCESS INVOLVED IN THE FACTORY



Process flow chart

Chapter II

LITERATURE REVIEW

2.1 GENERAL

The paper has reviewed the global boiler explosions fatalities with a special emphasis on boiler accidents occurred in the Indian subcontinent and suggested some remedial actions.

INFORMATION ABOUT THE LITREATURES

2.2 COMPLIANCE OF BOILER STANDARDS AND INDUSTRIALSAFETY IN INDIAN SUBCONTENT

The number of catastrophic boiler explosions and fatalities are increasing progressively in India and Bangladesh**.** Since 2012, which is shown in Figure 7. It is alarming to note that over 76% global deaths due to boiler explosion s occurred in the subcontinent. India topped the list with 34% of the global death, closely followed by Bangladesh (21%) and Pakistan (21%). The boiler explosion death in India is higher than Bangladesh or Pakistan as India's registered boiler numbers are significantly larger compared to Bangladesh and Pakistan combined. India, Bangladesh and Pakistan are also responsible for over 66% global boiler explosion related human injuries compared to the rest of the world's 34% (Figure 8). India again leads with 33% followed by Bangladesh (19%) and Pakistan (14%).In 1973, there were over 20,000 industrial boilers including roughly 500 power boilers in India [14, 17, and 20]. Most**.** Boiler used in textile industries, followed by rice mills, distilleries, engineering and chemical industries. The percentage of shell boilers was largest being about 78%, water tube 14.5%, and package 7.5% [14]. It is believed to be the boilers number in India in 2018 is over 100,000.

FIG 2.2 (a) GROOVER SHOE FACTORY BEFORE THE BOILEREXPLOSION ON 20 MARCH 1905

FIG 2.2 (b) GROOVER SHOE FACTORY AFTER THE BOILER EXPLOSION

2.3CRIMSUN ORGANICS PRIVATE LIMITED

A boiler blast on Thursday at Kudikadu village near Cuddalore, in Tamil Nadu, killed four persons and injured 15. The industrial accident happened at a pesticide manufacturing unit of Crimsun Organics Pvt Ltd at SIPCOT Industrial Estate. The plant was operating with 19 regular staffers and 18 contractual labourers when the blast happened, at 07:45 am. Thanks to COVID lockdown curbs, only 50% of the workforce had reported for duty. The boiler mixer machine burst Chemical gas emerged from the furnace of the boiler and spread nearby, which resulted in a fire accident around the plant the police said. A strong breeze fuelled the fire Residents who rushed out of their homes reported seeing thick plumes of smoke. Fire service was alerted and the personnel doused the fire. Four people including a 35-year-old woman were reported dead. The injured havebeen hospitalised. About 15 workers are trapped inside, and rescue efforts are on.

Fig 2.3 CRIMSUN ORGANICS PRIVATE LIMITED

2.4 BOILER BLAST IN BENGALURU FOOD FACTORY

Four persons were killed in a boiler explosion on August 23, Monday in a small-scale condiments factory in Bengaluru. Sourabh Kumar and Manish Kumar, both of them who were in their early twenties and hailed from Bihar’s Motihari district, were charred to death. Dhanalakshmi (52) and Sachin (40), the other two present on the factory floor during the accident, succumbed to their injuries on Tuesday morning at the Victoria Hospital's Burn Ward.

The explosion took place at 1:45 pm on Monday in the premises of MM Food Products factory located on Magadi road. The impact of the explosion was such that the asbestos sheet roof of the building was blown.

Fig 2.4 BOILER BLAST IN BENGALURU FOOD FACTORY

2.5 CONCLUSION OF LITERATURE

Based on the present study, the following remedies are suggested to alert boiler related accidents and explosion

- Create a pool of technical experts in boiler technology and operations to regulate the sector and maintain quality to avoid inherent risks.
- Strictly maintain Boiler Operation Log Program and Maintenance Log Program (on daily, weekly, monthly,semi-annual and annual basis).
- Arrange regular training programs on safety aspects for managers, engineers/operators, workers, weldersworking with the boilers.
- Develop a national database for boiler registrations, renewal, explosions, causes of explosions and remedialactions.
- Provide resources (skilled manpower, finance and equipment) to the National Boiler Board to carry out vested
- Duties and responsibilities as per national standard and/or international standards.
- Implement the software control the accident.

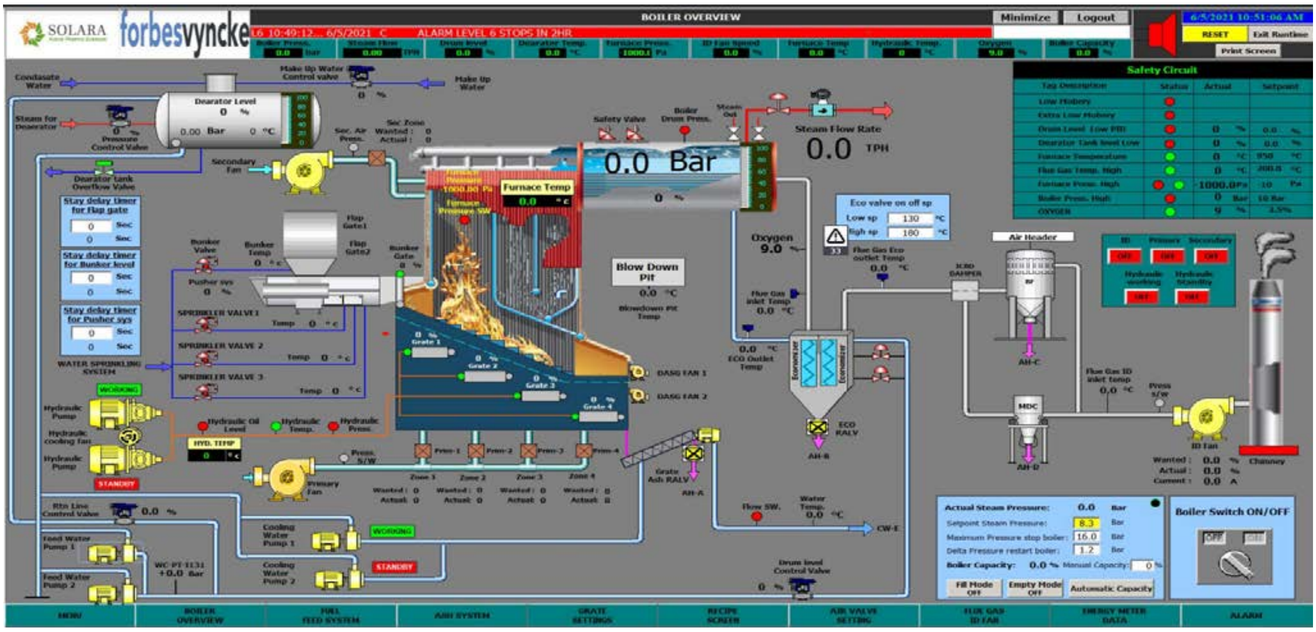
CHAPTER - III

INTRODUCTION ABOUT PROJECT

There has been tremendous increased in the demand of automated machine in industrial sector of power plants and with the greater efficiency and high quality. Continuous Monitoring and frequent inspection has to done in powerplants. There are possibilities of occurrence of errors while measuring. As microcontroller lack some features and also various stages involved with the human workers. That is what this explains the need of the automation in the industries.

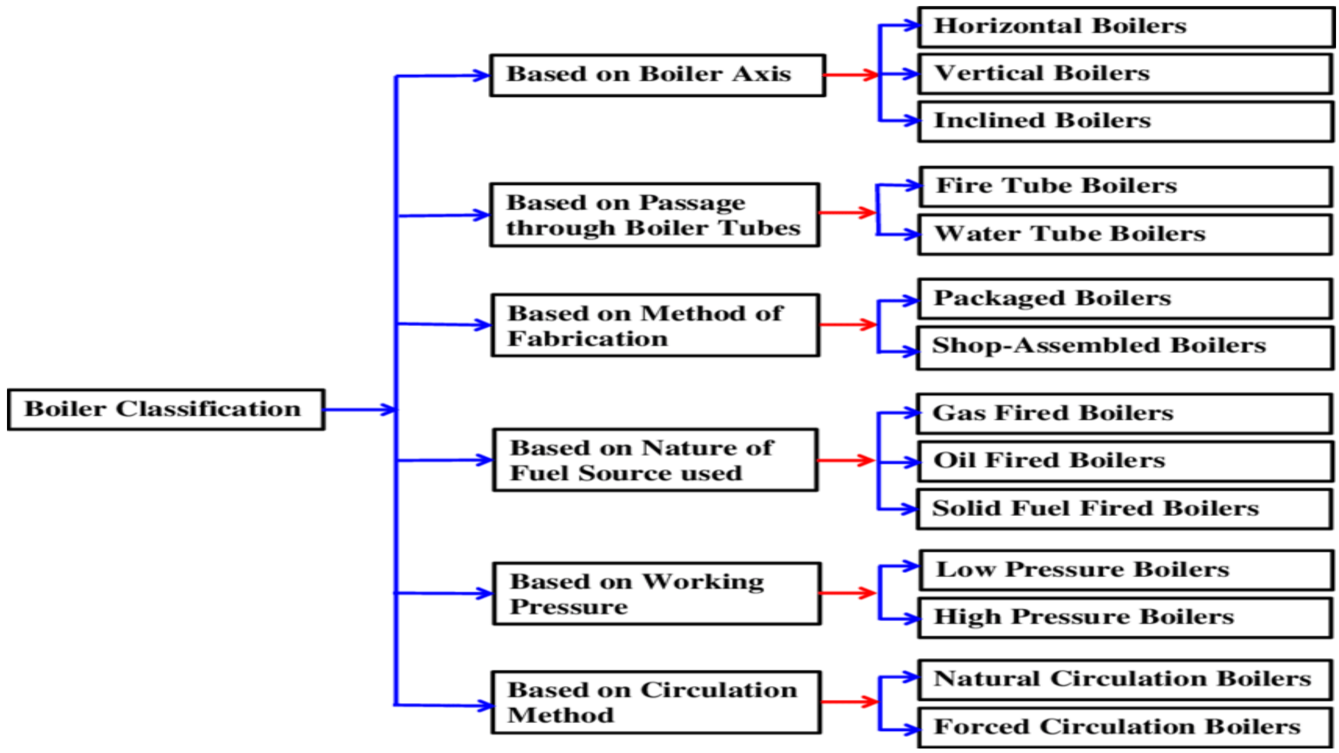
The boiler is the most important Equipment to produce steam in chemical industries like power plant and to increase the efficiency of automation the precise efforts is been taken.Chemical plants are totally based on boiler system. The very critical operation in any boiler system is to control the level of the water in the drum of the boiler. Nowadays, modern techniques are being used in the industries in place of the conventional techniques. The boiler systems which are multipurpose and which produce the by-products such as Heat, Steam and Chemical Gasses etc. are installed in the sugar industry. In many industries the steam generated by the plant instead of going to waste it is used for the generation of electricity generation. Various new methods of controlling the boiler system are installed so that the system works finely.

Fig.1 below is the basic structure of boiler.



The greater source as input to the sugarcane plant are fuel which is easily available, feed water and the air. The main output of the system is the steam pressure, steam temperature and the flue gasses electrical power and some of the heat loss. Boilers do have much strength which make them the greater feature of the system. They are durable have long life and can with stand with the climatic changes in surroundings, they can achieve the efficiency up to 95% or can go even further. They provide the effective method of heating and in case of system which is based on the steammay require little pumping or no pumping energy.

Boiler classification



DESIGN BASIS - GENERAL

TPH	TON PER HOUR	PA	Primary air
TDS	TOTAL DISSOLVED	SA	Secondary air
TH	TOTAL HARDNESS	VFD	Variable frequency drive
HMI	HUMAN MACHINE INFERANCE	FD	Forced draught
PH	POTENTIAL OF HYDROGEN	ID	Induced draught
MT	METRIC TON	ICBD	Inter cum by pass damper
RALV	ROTARY AIR LOCK VALVE	IBD	Intermediate blow down
KL	KILOLITER	SMDC	Submergible drag chain conveyor
O&M	OPERATION & MAINTENANCE	SPM	Suspended particulate matter
PPM	PARTS PER MILLION	PPE	Personal protective equipment

S.no	**Particular**	**UNIT**	**Description**
1	**Site Location**		Cuddalore, Tamil Nadu.
2	**Temperatures**		
	Maximum	°C	45
	Minimum	°C	15
	For Performance	°C	30
	For electrical design		30
3.	**Relative humidity**		
	For Performance	%	70
	Minimum	%	60
	Maximum	%	90
4.	**Site elevation**	MSL(M)	CTS
5	**Rain fall**	Annual avg (mm)	CTS
6	**Wind velocity**	m/s	CTS
	Wind direction		As per Is 875
7	**Seismic zone**		As per 1893 zone II
8	**Major codes**		
	Design		IBR
	Pressure parts		IBR
	Piping		IBR
	Fans		As per vendor standard
	Process valves		IBR

9	**Inspection**		
	Stage wise inspection		As per agreed QAP
	Final dispatch inspection		As per agreed plan
	Non pressure parts &bought out equipment		As per agreed QAP

DESIGN BASIS - BOILER

TYPE OF UNIT: Dynamically Air Cooled Step Grate (DAS), natural circulation, Smoke Tube + Water Tube Boiler

S.NO	Parameters	Unit	Value
1	Boiler type		Dynamically air cooled step grate (DAS)
2.	Number of boilers		1
3	Model		EP140
	Boiler capacity –F&A 30 Deg C	Kg/hr	12000
	Boiler capacity –F&A 100 Deg C	Kg/hr	**14000**
4	Boiler design pressure	Kg/cm^2	**10.5**
5	**Steam pressure**		
	Safety valve set pressure	Kg/cm^2	10.5/10.25
	Modulating pressure control range	Kg/cm^2	8.0-9.0
	Steam pressure at boiler outlet (at MSSV)	Kg/cm^2	8.5
6	Boiler turn down (%of rated capacity**)**	**%**	40-100
7.	Flue gas temp. at the inlet of chimney while firing performance guarantee fuel	°C	150+/-10
8	Boiler Thermal Efficiency @ 100 % Load on NCV Basis as per BS Pt I while firing Briquettes	**%**	84(+/-2)
9	Dryness fraction	**%**	98
10	**Mechanical details for boiler**		
	Steam & Water Drum Material		SA 515 Gr.70 / SA 516 Gr.70
	Drum shell / dished end thickness	(mm)	As per IBR
	Type of drum support		
	Drum Design code		
	Convection Tube size (OD x T)	Mm x Mm	
	Convection Tube material		
	Effective Length	M	
	Stay Tubes Thickness	Mm	
	Stay Tube Material		
	Tube Diameter	Mm	
	electrical & mechanical details May	change	

INDIAN STANDARD FOR BOILER

Indian Boilers Regulations - 1950. The Central Boilers Board, constituted under Section 27A of the Indian Boilers Act 1923 (5 of 1923) is responsible for making regulations for laying down the standards for materials, design, construction as well as for registration and inspection of boilers.

IS10496 (1983): Feed Water, Boiler Water and Condensate for High Pressure Boilers

Is 10391: 1982: codeof practice for chemical cleaning of boilers.

Is 10392: 1982: specification for feed water and boiler water for low and medium pressure boiler

Is 10496: 1983 specification boiler feed water and condensate pressure boiler

HAZARD IDENTIFICATION & RISK ASSESSMENT

HAZARD

A hazard is any object, situation, or behaviour that has the potential to cause injury, ill health, or damage to property or the environment.

Risk

Risk is defined in financial terms as the chance that an outcome or investment's actual gains will differ from an expected outcome or return. Risk includes the possibility of losing some or all of an original investment.

HAZOP

A hazard and operability study is a structured and systematic examination of a complex planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment.

Risk assessment is a step for Risk management. Risk assessment is determination of qualitative and quantitative value of risk related a situation or hazard. Hazard is a situation that poses a level of threat to life, health or environment. Disaster is a natural or man-made hazard resulting in an event of substantial extent causing significant physical damage or distraction loss of life or drastic change in environment. Hazard analysis involves the identification and quantification of the various hazards (unsafe condition) that exist in the plant. On the other hand, risk analysis deals with the identification and quantification of the risk, the project equipment and Personnel are exposed to, due to accidents resulting from the hazards present in the project. Risk analysis involves the identification and assessment of risks to the population exposed to hazards present. This requires an assessment of failure probability, credible accident scenario, vulnerability of population etc. Much of this information is difficult to get or generate consequently, the risk analysis in present case is confined to maximum credible accident studies and safety and risk aspect related to proposed grain based distillery and Co-Generation power plant. Risk assessment involves the following:

Contamination due to accidental releases or normal release in combination with natural hazard

• Deposition of toxic pollutants in vegetation / other sinks and possible sudden releases due to accidental occurrences.

Risk Analysis Methodologies Risk assessment often requires the synthesis of risk profiles, which represent the probability distribution of total annual loss due to a certain set of events or activities. These assessmentsusually involve estimation of losses for several sub-classifications of the overall process and synthesis of the results into an aggregate risk profile.

Main risk assessment technologies are:

HAZARD AND OPERABILITY STUDY (HAZOP) - The HAZOP study is a systematic technique of identifying hazards of operability problems of a process and lists all possible deviations from normal operating condition and how they might occur. The consequences of the process are assessed and the means available to detect and correct the deviations are examined. Thus, within the entire process all "credible" deviations that could lead to hazardous events or operability problems are identified.

FAULT TREE ANALYSIS (FTA)

FTA is primarily a means of analysing non-identifiable hazards. Hazards of top events (the ultimate happening that is to be avoided) are first identified by other techniques such as HAZOP. Then all combinations of individual failures that can lead to that hazardous event show the logical format of the fault tree. Estimating the individual probabilities and then using the appropriate arithmetical expressions can calculate the top event frequency.

Hazard Identification

- Vulnerability Analysis
- Risk analysis •
- Emergency plan Hazard Identification For the distillery unit four categories of hazards are identified and listed below.

• Natural Hazard

• Man made Hazard (such as fire, explosion, accidents, etc.)

Activities requiring assessment of risk due to occurrence of most probable instances of hazard and accident are both onsite and off-site.

On-site

• Exposure to fugitive dust, noise, and other emissions

• Housekeeping practices requiring contact with solid and liquid wastes

• Emission/spillage etc. from storage & handling Off-site

Off-site

• Exposure to pollutants released from offsite/ storage/related activities

• Contamination due to accidental releases or normal release in combination with natural hazard

• Deposition of toxic pollutants in vegetation / other sinks and possible sudden releases due to accidental occurrences.

Risk Analysis Methodologies;

Risk assessment often requires the synthesis of risk profiles, which represent the probability distribution of total annual loss due to a certain set of events or activities. These assessmentsusually involve estimation of losses for several sub-classifications of the overall process and synthesis of the results into an aggregate risk profile.

Identification of Hazardsin Boiler operation

Table: 1

s.no	Name	Description	Severity	Hazard
1	Transportation of raw material and storage	Grains	Minor	Accidents
		Coal	Major	Fire
		Rice husk	Major	Fire
		Enzymes, yeast, Nutrients, etc.	minor	Exposure &inhalation
		Chemical (caustic, acid etc.)	major	Exposure to skin
2	Manufacturing Process	Distillation	major	Heat& fire
3	Other Utilities	Boiler ,D.G sets	major	Noise ,heat, fire &electrocution
4	Products	Alcohol	major	Fire
5	Other accidents	Leakages from thevessels rupture of vessels and storage tanks	major	Exposure & fire

Hazard identification in a boiler

Assessment of risk along with mitigation measures

Qualitative risk assessment based on categorization of both probability and impact provides greater insight into the absolute risk severity. The risk impact assessment investigates the potential effect on a project objective such as schedule, cost, quality, or performance, including both negative effects for threats and positive effects for opportunities.

S.NO.	Activity	Associated hazards	Associated risk/ health impact	Risk rating	Mitigation Measures
1	Storage & handling of raw materials, chemicals	Exposure, fire, leakage, explosion	Exposure, physical injuries, burn,	H	Use of PPEs. • Inspection & regular monitoring • Training to workers for proper handling • Proper system for loading operation to prevents spillage • Spill kit for Acid and other chemicals • Provision of first aid boxes • Proper ventilation
2	Working near fermentation vessels & distillation column	Bursting of fermentation vessel, heat, fire	Severe burns & physical injuries	H	• Proper Ventilation • Provision of pressure indicators in The vessels. • Use of PPEs. • Inspection & regular monitoring • Training to workers for proper handling • Provision of firefighting facility
3	Fuel yard	Fire	burns, physical injuries, respiratory disorders	H	• Storage should be away from ignition source • Firefighting facility shall be provided • PPEs should be provided • First aid box
4	APCD failure	Release of PM in ambient air	Air pollution	H	• Regular monitoring & Inspection. Shall be done. • The plant shall immediately shut down on APCD failure
5	Working at height	Slip, trips & falls of operators	Physical injuries	H	• Individual alertness of the Workers. • First aid boxes shall be provided
6	Storage of Alcohol	Exposure, inhalation, ingestion & fire	Exposure to over 100 ppm may cause headache, drowsiness, etc. Ingestion may lead to depression of CNS, nausea, etc. Burn injuries.	H	• Well ventilation • Keeping away from heat sparks & Open flame. • PPEs. • Firefighting measures shall be Readily available.
7	Release of High pressure steam from boiler	Explosion	Risk of severe injuries, damage to equipment	H	Regular maintenance & inspection of parts. • Proper training to the individuals • PPEs • First aid kit
8	Electrical maintenance work	Electric shock, short circuits in	Electric shocks, injury or burn	H	• Regular checking and maintenance of electrical units

		power room			• PPEs • Provision of First aid box
9	Working near boiler, D.G. Sets	High noise	Noise induced hearing losses	M	• Provision of PPEs to the workers

Risk Priority Number

Risk priority number (*RPN*) is a function of the three parameters discussed above, viz, the severity of the effect of failure, the probability of occurrence, and the ease of detection for each failure mode. *RPN* is calculated by multiplying these three numbers as per the formula below,

RPN=S×P×D

Where *S* is the severity of the effect of failure, *P* is the probability of failure, and *D* is the ease of detection.

Critical Parameters

Level Control:

Steam Drum level

De-aerator level

Hot well level

Boiler start-up check list

Pre-start up Safety Review for Boiler

Pressure Control:

Force draft pressure

Induced draft pressure

Steam Drum pressure

De-aerator pressure

Turbine inlet steam pressure

Balanced draft pressure

Flow Control:

Air flow

Steam flow

Water flow

Temperature Control:

De-aerator temperature

Steam drum temperature

Under-bed boiler temperature

Turbine inlet steam temperature

Flue gas temperature

S.NO	Check Points	Status
1	Check all Permit to work system (Hot work/ Electrical work / Confined Space) closed.	Ensured
2	Ensure LOTO (Lock Out & Tag Out) removed from MCC panels.	Ensured
3	Ensure boiler and its auxiliary’s manual is kept closed.	Ensured
4	Ensure boiler feed water tank level condition min 50-60% is maintained.	Ensured
5	Ensure all boiler start permissive in healthy condition	Ensured
6	Check Boiler bunker level is in full condition.	Ensured
7	Ensure boiler drum level having minimum 40% is maintained.	Ensured
8	Ensure man / material is not there inside the furnace.	Ensured
9	Ensure boiler drum air vent valve is in open condition.	Ensured
10	Check the healthy condition of fan and pump before firing	Ensured
11	Ensure the bio briquettes filled in moving grate and check arrangements for Manual ignition.	Ensured
12	After catching of fire, Induced Draft fan, Primary & Secondary air fans are in Sequence	Ensured

13	Ensure furnace draught control pressure between (-6 to +3)	Ensured
14	Ensure gradually rising of pressure slowly up to 2 Kg/cm2	Ensured
15	Ensure air vent valve is closed, after 2 Kg/cm2 pressure is raised in drum.	Ensured
16	Once the pressure is reached 6-8 Kg/cm2 concurrence to be obtained for Low Pressure/ High Pressure steam.	Ensured
17	Ensure all Fuel handling plant area is in clean condition.	Ensured
18	Ensure all pull guard switches are in released condition.	Ensured
19	Ensure all Permit to work system (Hot work, General work, Confined space Height work) are closed.	Ensured
20	Ensure Belt#1, Belt#2 crusher start permissive in health condition.	Ensured
21	Ensure Belt Conveyor#1, Belt Conveyor #2, Crusher and Dust Extraction System blower are in sequence.	Ensured

Scope: This procedure is applicable for operation and maintenance of boiler

ABREVATION:

TPH	TON PER HOUR	PA	Primary air
TDS	TOTAL DISSOLVED	SA	Secondary air
TH	TOTAL HARDNESS	VFD	Variable frequency drive
HMI	HUMAN MACHINE INFERANCE	FD	Forced draught
PH	POTENTIAL OF HYDROGEN	ID	Induced draught
MT	METRIC TON	ICBD	Inter cum by pass damper
RALV	ROTARY AIR LOCK VALVE	IBD	Intermediate blow down
KL	KILOLITER	SMDC	Submergible drag chain conveyor
O&M	OPERATION & MAINTENANCE	SPM	Suspended particulate matter
PPM	PARTS PER MILLION	PPE	Personal protective equipment

Safety Analysis

Tittle of method statement	**Safety Analysis**	**Date**
Description of Activity	Operation and maintenance of boiler ,Fuel handling system	

step	**Description**	**Hazard**	**Control**
1	Review the manufacturer's recommendations for start-up of the boiler.	Explosion Pressure Container	Only qualified people may perform this task. You must be authorized by the manager of facilities and maintenance
	Boiler operation 1. Ensure the boiler feed water quality as per the norms (pH - 8.5 to 9.5, refer p&id) 2. Check that the feed water tank level is full (Min. level 60%) 3. Ensure that the pump suction strainer cleaned 4. Put on the main electric switch and observe that 3-phase Incoming supply is available. 5. Select water pumps No.1 or No.2 in SCADA Screen 6. While there is NO water in the boiler select the Moberly switch, Pump Inching switch and Observes that two safety lamps (low level and extra low level) are ON and alarm sounds. The water pumps will also start running. 7. Open the air vent valve. Put switch in Moberly manual position. Water pump will start running and water level starts rising in boiler. Water pump indication will be ON. 8. After reaching working level water pump will stop and this indication will go OFF. 9. Check and ensure that all other safeties are within acceptable limits and the water level is enough. 10. Check and ensure that sufficient quantity of	1.Explosion in boiler due to over pressure and temperature 2.Explosion in boiler due to improper combustion of fuel 3.Back fire 4.Burn injury due to hot water and hot steam pipeline leakage 5.Exposure to the hot surface of pipeline or machineries 6.Water tube burst due to Failure in boiler water level control 7.Burn injury by hot fly ash Catches on the moving part of the machinery like F.D. fans, PA Fan, Belt Conveyors, Screws or motors Burst of the equipment body due to over pressure	1. That the feed water, condensate water, Make up (RO) water and boiler blow down water is checked after every four hours of boiler operation or more frequently. If abnormal is found, ensure the chemical dosage and control the dosing according to the parameters 2. That no excessive sound is coming from rotary equipment's. 3. That all valves and joints are leak proof 4. That no part of boiler body is getting overheated. 5. If the water pump is working on-off so as to ensure the functioning of Mobrey level control switches or control valve and it should be ensured that proper water flow is maintained. 6. That the exhaust from the chimney is normal. 7. That no sparking or loose contact is there in the electric circuit. 8. That all the controls and safety devices are working satisfactorily. 9. That a steady steam pressure and water level is maintained within desired range is maintained. 10. That no over firing of fuel is being done. 11. Blow down the boiler at regular intervals. The blow down frequency will depend upon the quality of water being used for the boiler.

	briquettes in fuel bunker. 11. Check and ensure that all dampers are in 100% open condition from shell outlet to ID fan suction and ensure that ICBD is closed i.e. Cyclomax in line. 12. Start all RAV's in flue gas path 13. Poured about 5kg of diesel soaked solid briquettes in moving grate. 14. Ignite the fuel and watch the flame. Furnace pressure to be maintained 0 mmwc while stating to enhance the effective flame. 15. After healthy flame picking up, start the ID fan, PA and SA fan on sequence order. 16. Start check the Grate zones Auto mode and start the fuel feeders At 40 % boiler capacity and gradually feed the crushed briquettes into the furnace. 17. Gradually increase the fuel feeding rate and increase the FD air by opening the damper accordingly, observes all will operate in auto. 18. After reaching drum pressure at 2 kg/cm2, boiler vent valve to be closed. 19. After reaching boiler steam pressure 8 kg/cm2, to be informed to end users and gradually open main steam stop valve, HP steam valve and LP steam valve. 20.Enter in the logbook :-- (a) Date and time of start-up--(b) Any irregularities observed and corrective action taken--(c) Time when control shut off	and over temperature Slip , trip and from the height during routine work, maintenance or inspection	Regulate the continuous blow down quantity according to the TDS in water. 12. Blow down the Mobrey Level Switch and the gauge glasses once in a shift. 13. Drain slightly the feed water tank once in a shift, to remove any sediment that may have settled down. 14. Keep a record of SPM readings. 15. Check that the clean fires and remove ash if level rises MG. 16. Maintain furnace draught within –170 to -150 Pascal. Adjust by ID fan speed settings. 17. Ensure that the stack temperature is within desired range for given load. If higher, check for fouling of heat transfer surface or blockage of flue gas passage. Clean the boiler periodically. 18. Check and maintain motor currents for PA Fan, SA Fan, and ID Fan, Feed water pump etc. within limit and record them in log book. 19. The unburnt in the ash should be less. (Monitor cleaning frequency) 20. Ensure that no air infiltration in flue gas passage is taking place. 21. Check for uniform combustion all over the bed. 22. Ensure that all readings (and abnormalities) are recorded correctly in log book, including chemical charges, blow down etc. 23. Ensure that all the maintenance instructions are followed religiously

	burner at established pressure, tests performed, etc.--(d) Signature of operator. 21. Record the boiler steam high pressure alarm and tripping pressure. 22. Check the drum level and check the blow down at regular interval to maintain the TDS below 3000 ppm		
step	**Description**	**Hazard**	**Control**
1	Review the manufacturer's recommendations for start-up of the boiler.	Explosion Pressure Container	Only qualified people may perform this task. You must be authorized by the manager of facilities and maintenance
	Boiler operation 1. Ensure the boiler feed water quality as per the norms (pH - 8.5 to 9.5, refer p&id) 2. Check that the feed water tank level is full (Min. level 60%) 3. Ensure that the pump suction strainer cleaned 4. Put on the main electric switch and observe that 3-phase Incoming supply is available. 5. Select water pumps No.1 or No.2 in SCADA Screen 6. While there is NO water in the boiler select the Moberly switch, Pump Inching switch and Observes that two safety lamps (low level and extra low level) are ON and alarm sounds. The water pumps will also start running. 7. Open the air vent valve. Put switch in Moberly manual position. Water pump will start running and water level starts rising in boiler. Water pump indication will be ON.	1.Explosion in boiler due to over pressure and temperature 2.Explosion in boiler due to improper combustion of fuel 3.Back fire 4.Burn injury due to hot water and hot steam pipeline leakage 5.Exposure to the hot surface of pipeline or machineries 6.Water tube burst due to Failure in boiler water level control 7.Burn injury by hot fly ash Catches on the moving part of the machinery	1. That the feed water, condensate water, Make up (RO) water and boiler blow down water is checked after every four hours of boiler operation or more frequently. If abnormal is found, ensure the chemical dosage and control the dosing according to the parameters 2. That no excessive sound is coming from rotary equipment's. 3. That all valves and joints are leak proof 4. That no part of boiler body is getting overheated. 5. If the water pump is working on-off so as to ensure the functioning of Mobrey level control switches or control valve and it should be ensured that proper water flow is maintained. 6. That the exhaust from the chimney is normal. 7. That no sparking or loose contact is there in the electric circuit. 8. That all the controls and safety devices are working satisfactorily. 9. That a steady steam

	8. After reaching working level water pump will stop and this indication will go OFF. 9. Check and ensure that all other safeties are within acceptable limits and the water level is enough. 10. Check and ensure that sufficient quantity of briquettes in fuel bunker. 11. Check and ensure that all dampers are in 100% open condition from shell outlet to ID fan suction and ensure that ICBD is closed i.e. Cyclomax in line. 12. Start all RAV's in flue gas path 13. Poured about 5kg of diesel soaked solid briquettes in moving grate. 14. Ignite the fuel and watch the flame. Furnace pressure to be maintained 0 mmwc while stating to enhance the effective flame. 15. After healthy flame picking up, start the ID fan, PA and SA fan on sequence order. 16. Start check the Grate zones Auto mode and start the fuel feeders At 40 % boiler capacity and gradually feed the crushed briquettes into the furnace. 17. Gradually increase the fuel feeding rate and increase the FD air by opening the damper accordingly, observes all will operate in auto. 18. After reaching drum pressure at 2 kg/cm2, boiler vent valve to be closed. 19. After reaching boiler steam pressure 8 kg/cm2, to	like F.D. fans, PA Fan, Belt Conveyors, Screws or motors Burst of the equipment body due to over pressure and over temperature Slip , trip and from the height during routine work, maintenance or inspection	pressure and water level is maintained within desired range is maintained. 10. That no over firing of fuel is being done. 11. Blow down the boiler at regular intervals. The blow down frequency will depend upon the quality of water being used for the boiler. Regulate the continuous blow down quantity according to the TDS in water. 12. Blow down the Mobrey Level Switch and the gauge glasses once in a shift. 13. Drain slightly the feed water tank once in a shift, to remove any sediment that may have settled down. 14. Keep a record of SPM readings. 15. Check that the clean fires and remove ash if level rises MG. 16. Maintain furnace draught within –170 to -150 Pascal. Adjust by ID fan speed settings. 17. Ensure that the stack temperature is within desired range for given load. If higher, check for fouling of heat transfer surface or blockage of flue gas passage. Clean the boiler periodically. 18. Check and maintain motor currents for PA Fan, SA Fan, and ID Fan, Feed water pump etc. within limit and record them in log book. 19. The unburnt in the ash should be less. (Monitor cleaning frequency) 20. Ensure that no air infiltration in flue gas passage is taking place. 21. Check for uniform combustion all over the bed. 22. Ensure that all readings (and abnormalities) are recorded correctly in log book, including chemical

	be informed to end users and gradually open main steam stop valve, HP steam valve and LP steam valve. 20.Enter in the logbook :-- (a) Date and time of start-up--(b) Any irregularities observed and corrective action taken--(c) Time when control shut off burner at established pressure, tests performed, etc.--(d) Signature of operator. 21. Record the boiler steam high pressure alarm and tripping pressure. 22. Check the drum level and check the blow down at regular interval to maintain the TDS below 3000 ppm		charges, blow down etc. 23. Ensure that all the maintenance instructions are followed religiously
step	**Description**	**Hazard**	**Control**
1	Review the manufacturer's recommendations for start-up of the boiler.	Explosion Pressure Container	Only qualified people may perform this task. You must be authorized by the manager of facilities and maintenance
	Boiler operation 1. Ensure the boiler feed water quality as per the norms (pH - 8.5 to 9.5, refer p&id) 2. Check that the feed water tank level is full (Min. level 60%) 3. Ensure that the pump suction strainer cleaned 4. Put on the main electric switch and observe that 3-phase Incoming supply is available. 5. Select water pumps No.1 or No.2 in SCADA Screen 6. While there is NO water in the boiler select the Moberly switch, Pump Inching switch and Observes that two safety lamps (low level and extra low level) are ON and	1.Explosion in boiler due to over pressure and temperature 2.Explosio n in boiler due to improper combustio n of fuel 3.Back fire 4.Burn injury due to hot water and hot steam pipeline leakage 5.Exposure to the hot surface of pipeline or machineries 6.Water tube burst due to	1. That the feed water, condensate water, Make up (RO) water and boiler blow down water is checked after every four hours of boiler operation or more frequently. If abnormal is found, ensure the chemical dosage and control the dosing according to the parameters 2. That no excessive sound is coming from rotary equipment's. 3. That all valves and joints are leak proof 4. That no part of boiler body is getting overheated. 5. If the water pump is working on-off so as to ensure the functioning of Mobrey level control switches or control valve and it should be ensured that proper water flow is

	alarm sounds. The water pumps will also start running. 7. Open the air vent valve. Put switch in Moberly manual position. Water pump will start running and water level starts rising in boiler. Water pump indication will be ON. 8. After reaching working level water pump will stop and this indication will go OFF. 9. Check and ensure that all other safeties are within acceptable limits and the water level is enough. 10. Check and ensure that sufficient quantity of briquettes in fuel bunker. 11. Check and ensure that all dampers are in 100% open condition from shell outlet to ID fan suction and ensure that ICBD is closed i.e. Cyclomax in line. 12. Start all RAV's in flue gas path 13. Poured about 5kg of diesel soaked solid briquettes in moving grate. 14. Ignite the fuel and watch the flame. Furnace pressure to be maintained 0 mmwc while stating to enhance the effective flame. 15. After healthy flame picking up, start the ID fan, PA and SA fan on sequence order. 16. Start check the Grate zones Auto mode and start the fuel feeders At 40 % boiler capacity and gradually feed the crushed briquettes into the furnace. 17. Gradually increase the fuel feeding rate and	Failure in boiler water level control 7.Burn injury by hot fly ash Catches on the moving part of the machinery like F.D. fans, PA Fan, Belt Conveyors, Screws or motors Burst of the equipment body due to over pressure and over temperature Slip , trip and from the height during routine work, maintenance or inspection	maintained. 6. That the exhaust from the chimney is normal. 7. That no sparking or loose contact is there in the electric circuit. 8. That all the controls and safety devices are working satisfactorily. 9. That a steady steam pressure and water level is maintained within desired range is maintained. 10. That no over firing of fuel is being done. 11. Blow down the boiler at regular intervals. The blow down frequency will depend upon the quality of water being used for the boiler. Regulate the continuous blow down quantity according to the TDS in water. 12. Blow down the Mobrey Level Switch and the gauge glasses once in a shift. 13. Drain slightly the feed water tank once in a shift, to remove any sediment that may have settled down. 14. Keep a record of SPM readings. 15. Check that the clean fires and remove ash if level rises MG. 16. Maintain furnace draught within –170 to -150 Pascal. Adjust by ID fan speed settings. 17. Ensure that the stack temperature is within desired range for given load. If higher, check for fouling of heat transfer surface or blockage of flue gas passage. Clean the boiler periodically. 18. Check and maintain motor currents for PA Fan, SA Fan, and ID Fan, Feed water pump etc. within limit and record them in log book. 19. The unburnt in the ash should be less. (Monitor

	increase the FD air by opening the damper accordingly, observes all will operate in auto. 18. After reaching drum pressure at 2 kg/cm2, boiler vent valve to be closed. 19. After reaching boiler steam pressure 8 kg/cm2, to be informed to end users and gradually open main steam stop valve, HP steam valve and LP steam valve. 20.Enter in the logbook :--(a) Date and time of start-up--(b) Any irregularities observed and corrective action taken--(c) Time when control shut off burner at established pressure, tests performed, etc.--(d) Signature of operator. 21. Record the boiler steam high pressure alarm and tripping pressure. 22. Check the drum level and check the blow down at regular interval to maintain the TDS below 3000 ppm		cleaning frequency) 20. Ensure that no air infiltration in flue gas passage is taking place. 21. Check for uniform combustion all over the bed. 22. Ensure that all readings (and abnormalities) are recorded correctly in log book, including chemical charges, blow down etc. 23. Ensure that all the maintenance instructions are followed religiously
step	**Description**	**Hazard**	**Control**
1	Review the manufacturer's recommendations for start-up of the boiler.	Explosion Pressure Container	Only qualified people may perform this task. You must be authorized by the manager of facilities and maintenance
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	5. Select water pumps No.1 or No.2 in SCADA Screen 6. While there is NO water in the boiler select the Moberly switch, Pump Inching switch and Observes that two safety lamps (low level and extra low level) are ON and alarm sounds. The water pumps will also start running. 7. Open the air vent valve. Put switch in Moberly manual position. Water pump will start running and water level starts rising in boiler. Water pump indication will be ON. 8. After reaching working level water pump will stop and this indication will go OFF. 9. Check and ensure that all other safeties are within acceptable limits and the water level is enough. 10. Check and ensure that sufficient quantity of briquettes in fuel bunker. 11. Check and ensure that all dampers are in 100% open condition from shell outlet to ID fan suction and ensure that ICBD is closed i.e. Cyclomax in line. 12. Start all RAV's in flue gas path 13. Poured about 5kg of diesel soaked solid briquettes in moving grate. 14. Ignite the fuel and watch the flame. Furnace pressure to be maintained 0 mmwc while stating to enhance the effective flame. 15. After healthy flame picking up, start the ID fan, PA and SA fan on	and hot steam pipeline leakage 5.Exposure to the hot surface of pipeline or machineries 6.Water tube burst due to Failure in boiler water level control 7.Burn injury by hot fly ash Catches on the moving part of the machinery like F.D. fans, PA Fan, Belt Conveyors, Screws or motors Burst of the equipment body due to over pressure and over temperature Slip , trip and from the height during routine work, maintenance or inspection	are leak proof 4. That no part of boiler body is getting overheated. 5. If the water pump is working on-off so as to ensure the functioning of Mobrey level control switches or control valve and it should be ensured that proper water flow is maintained. 6. That the exhaust from the chimney is normal. 7. That no sparking or loose contact is there in the electric circuit. 8. That all the controls and safety devices are working satisfactorily. 9. That a steady steam pressure and water level is maintained within desired range is maintained. 10. That no over firing of fuel is being done. 11. Blow down the boiler at regular intervals. The blow down frequency will depend upon the quality of water being used for the boiler. Regulate the continuous blow down quantity according to the TDS in water. 12. Blow down the Mobrey Level Switch and the gauge glasses once in a shift. 13. Drain slightly the feed water tank once in a shift, to remove any sediment that may have settled down. 14. Keep a record of SPM readings. 15. Check that the clean fires and remove ash if level rises MG. 16. Maintain furnace draught within –170 to -150 Pascal. Adjust by ID fan speed settings. 17. Ensure that the stack temperature is within desired range for given load. If higher, check for fouling of

	sequence order. 16. Start check the Grate zones Auto mode and start the fuel feeders At 40 % boiler capacity and gradually feed the crushed briquettes into the furnace. 17. Gradually increase the fuel feeding rate and increase the FD air by opening the damper accordingly, observes all will operate in auto. 18. After reaching drum pressure at 2 kg/cm2, boiler vent valve to be closed. 19. After reaching boiler steam pressure 8 kg/cm2, to be informed to end users and gradually open main steam stop valve, HP steam valve and LP steam valve. 20.Enter in the logbook :--(a) Date and time of start-up--(b) Any irregularities observed and corrective action taken--(c) Time when control shut off burner at established pressure, tests performed, etc.--(d) Signature of operator. 21. Record the boiler steam high pressure alarm and tripping pressure. 22. Check the drum level and check the blow down at regular interval to maintain the TDS below 3000 ppm		heat transfer surface or blockage of flue gas passage. Clean the boiler periodically. 18. Check and maintain motor currents for PA Fan, SA Fan, and ID Fan, Feed water pump etc. within limit and record them in log book. 19. The unburnt in the ash should be less. (Monitor cleaning frequency) 20. Ensure that no air infiltration in flue gas passage is taking place. 21. Check for uniform combustion all over the bed. 22. Ensure that all readings (and abnormalities) are recorded correctly in log book, including chemical charges, blow down etc. 23. Ensure that all the maintenance instructions are followed religiously

CHAPTER -IV

INTRODUCTION OF SCADA, PLC, HMI

INTRODUCTION TO AUTOMATION

Automation is the use of control systems such as computers to control industrial machinery and process, reducing the need for human intervention. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with physical requirements of work, automation greatly reduces the need for human

Sensory and mental requirements as well. Processes and systems can also be

Automated.

AUTOMATION IMPACTS:

1. It increases productivity and reduce cost.
2. It gives emphasis on flexibility and convertibility of manufacturing process. Hence gives manufacturers the ability to easily switch from manufacturing Product A to manufacturing product B without completely rebuilt the existing system/product lines.
3. Automation is now often applied primarily to increase quality in the manufacturing process, where automation can increase quality substantially.
4. Increase the consistency of output.
5. Replacing humans in tasks done in dangerous environments.

FEATURES OF PLCS

1. PLC is an industrial computer control system that continuously monitorsthe state of input devices and makes decisions based upon a custom program to control the state of output devices.

2. It is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact.

3. Almost any production process can greatly enhanced using this type ofcontrol system, the biggest benefit in using a PLC is the ability to changeand replicate the operation or process while collecting and communicating vital information.

4. It is modular i.e. one can mix and match the types of input and output

Devices to best suit one's application.

COMPONENTS OF PLC:

The PLC mainly consists of a CPU, memory areas, and appropriate circuits toreceive input/output data. We can actually consider the PLC to be a box fullof hundreds or thousands of separate relays, counters, timers and data storagelocations. Each component of a PLC has a specific function:

1. The CPU is the brain of a PLC system. It consists of the microprocessor, memory integrated circuits and circuits necessary to store and retrieve information from memory. It also includes communication ports to the peripherals, other PLCs or programming terminals. The job of the processor is to monitor status or state of input devices, scan and solve the logic of a user program, and control on or off state of output devices.

2. Counters - These are simulated counters and they can be programmed tocount pulses. Typically these counters can count up, down or both up anddown. Since they are simulated they are limited in their counting speed.Some manufacturers also include high-speed counters that are hardwarebased. We can think of these as physically existing.

3. Timers - These come in many varieties and increments. The most common type is an on-delay type. Others include off-delay and both retentiveand non-retentive types. Increments vary from 1 millisecond to 1 second.

4. Output Relays (coils) - These are connected to the outside world. Theyphysically exist and send on/off signals to solenoids, lights, etc. They canbe transistors, relays depending upon the model chosen.

5. Data Storage - Typically there are registers assigned to simply store data. They are usually used as temporary storage for math or data manipulation. They can also typically be used to store data when power is removed from the PLC. Upon power-up they will still have the same contents as before power was removed.

SCADA

INTRODUCTION

SCADA stands for Supervisory Control and Data Acquisition. As the name indicates, it is not a full control system, but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hardware to which it is interfaced, in general via PLC. SCADA systems are now also penetrating the experimental physics laboratories for the controls of ancillary systems such as cooling, ventilation, power distribution, etc. More recently they were also applied for the controls of smaller size particle detectors such as the L3 moon detector and the NA48 experiment, to name just two examples atCERN.

SCADA systems have made substantial progress over the recent years interms of functionality, scalability, performance and openness such that they area alternative to in house development even for very demanding and complex control systems as those of physics experiments.

The process can be industrial, infrastructure or facility based as describedbelow:

1. Industrial Process: it includes those of manufacturing, production, powergeneration, fabrication and refining and process may be in continuous,batch, repetitive or discrete modes.
2. Infrastructure Process: it may be public or private, and water treatment and distribution, wastewater collection and treatment, oil and gas pipelines, electrical power transmission and distribution, and large communicationsystems.
3. Facility Process: it occur both in public facilities and private ones, including buildings, airports, ships and space stations. They monitor andcontrol HVAC, access and energy consumption.

A SCADA System usually consists of the following Subsystems:

1. A Human-Machine Interface (HMI) is the apparatus which presents process data to a human operator, and through this, the human operator monitors and controls the process.
2. A supervisory (computer) system, gathering (acquiring) data on the process and sending commands (control) to the process
3.Remote Terminal Units (RTU) connecting to sensors in the process, converting sensor signals to digital data and sending digital data to the supervisory system.
4. Programmable Logic Controller (PLC) used as field devices because theyare more economical, versatile, flexible, and configurable than special purpose RTUs.
5. Communication infrastructure connecting the supervisory system to the Remote Terminal Units.

Manufacturers of SCADA

1. Allen Bradley: RS View
2. Siemens: win cc
3. Wonderware : InTouch

3.4 Features of SCADA

1. Dynamic Process Graphic
2. Alarm summary
3. Alarm history
4. Real time trend
5. Historical time trend.

Security (Application Security)

7. Data base connectivity
8. Device connectivity
9. Scripts
10. Recipe management

Project Using PLC: Glowing of four LED using START, STOP and SELECTOR Switches

CHAPTER-V
METHODOLOGY

The automation technique involving the automatic control of all the process which includes the monitoring, controlling, Alarming and inspection needs provides for a very efficient system. All the values can be filled up by the introduction of the automation technique into the boiler.This could be applied to every process in the plant. The automation in boiler, reduce the amount of the errors that occur, reduction in the human resources, increased efficiency and most important very cost effective. Automation makes it possible to measure, calculate, and estimate and monitor the production efficiency, direct cost lifetime costs, emission and all the interdependencies between them. It enables the plant to optimize and control its operations correspondingly. The operators and contractors of new, large sugar / power plants understand well the benefits of automation. But in smaller units, it is not yet clear to every user that a modern automation system gives clear benefits when compared with compared with a Manual system is, for instance, in connection with the modernization of boiler combustion technology or the system controller. While an average industrial power boiler has a lifespan of up to 50 years or more, replacing one can be a costly investment. The natural consequences of associate degree aging are reduced dependableness, exaggerated maintenance value and lower performance. Betting on the age of a specific boiler and its

Projected remaining helpful life, makers typically have sturdy economic incentives to retrofit system elements to stay the boiler operative at optimum capability and potency. The Choice of once and the way to upgrade associate degree existing boiler may be driven by variety of things.

Let's say,How previous is that the boiler and once was it last Upgraded?

Is the system meeting desired dependableness and potency goals?

Are major operative elements changing into expensive to take care of or replace?

Is there a requirement to exchange the burner'sto accommodate a special sort of fuel?

Are there associate degree close restrictive changes on thehorizon that will need an update in operative or managementspecification?

A good beginning purpose is examination of the boiler'soperation and maintenance prices.

Are period or labour prices overly high?

Are replacement elements changing into too overpriced or troublesome to find?

Many time these value are hidden among your overall maintenance budget. Obviously, it doesn't add up to stay investment in associate degree superannuated unit once discount within the in progress operation and maintenance value can justify a brand new or well upgraded unit.

Another variable which will issue into the upgrade equations fuel value. Let's say, if your existing unit is meant to fireside inferior heating oil, you will wish to gauge a higher performing, additional cost-effective fuel different. During this case, subsequent step would be to look at the conversion value, alongside operation, maintenance and potency projections to envision if it is smart to contemplate exchange the prevailing burner to accommodate a special fuel supply.

A Various parameters Indication systems for better Performance of Boilers

1. Feed Water Temperature Indicator
2. Steam Temperature Indicator
3. Flue Gas Temperature Indicator
4. Furnace Temperature Indicator
5. Temperature Indicator for Air Heater Inlet andOutlet
6. Temperature Indicator for Economizer Inlet andOutlet
7. Main Steam Pressure Indicator
8. Draught Indicator
9. PH. Indicator for Feed water
10. TDS Indicator for Feed water
11. Co2 Analyser from the Stack Monitoring
12. O2 Analyser for Stack Monitoring
13. Feed Water Flow Meter
14. Vibration Indication for Feed Pump/I.D. /F.D. FanMotors

B Various DCS Base Control System for Safety and Fine Operation of Boilers

1. Three Element Boiler Drum Level Control System
2. Combustion Control System
3. De-aerator Level and Pressure Control System
4. Attempter Temperature Control Systems
5. Auto Blow down Control System
6. H.P. Heater Level Control Systems

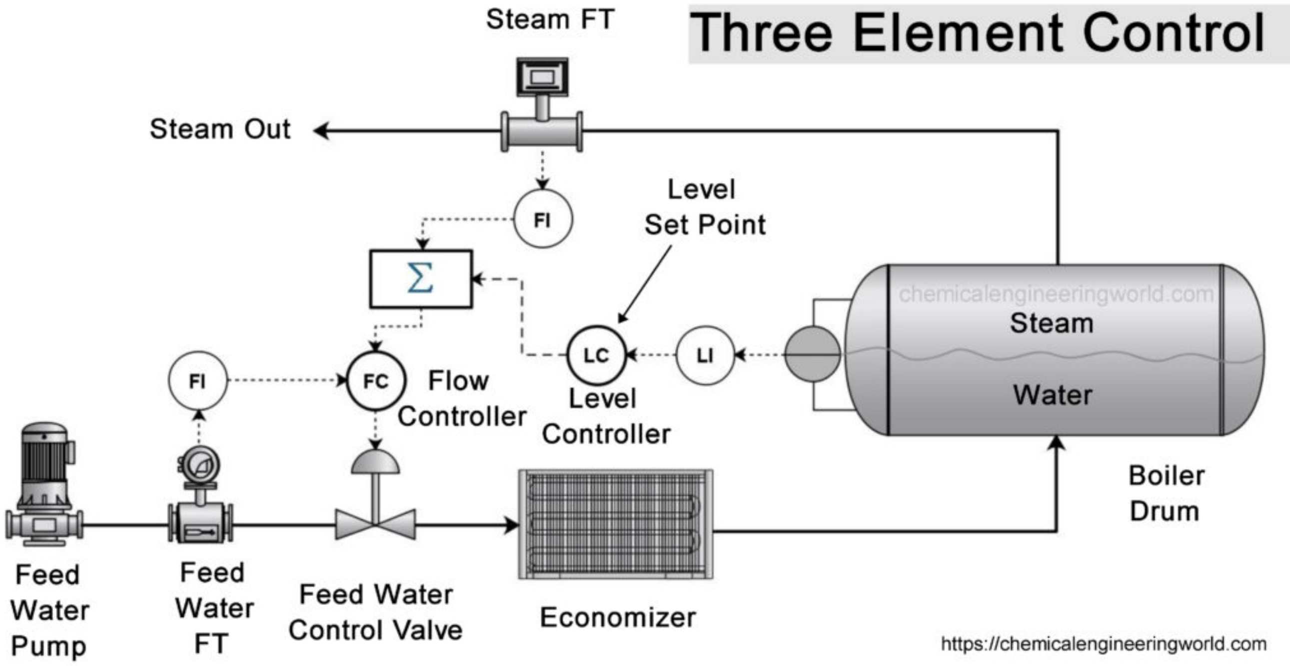
C Alarm and Annunciation System for Various Parameters

1. Temperature
2. Pressure
3. Level
4. Feed Pump ON/OFF Condition
5. Co2 and O2 Levels
6. TDS /PH / Silica Levels

Feed water Flow element: This is quick in response and rapidly to the difference feed water requirement fromeither steam flow rate feed water signal or the feed water pressure or the flow fluctuations.

If we want to achieve the optimum control over both steam feed water flow it is necessary to correct the values for density.

The three element system provides compact control for thedrum level with unsteady steam load.



Enhanced three element drum level control:

The three element system is used only when there is demand of high steam. The two element system is used only when there is failure in the measurement of steam flow and the single element system is used when there is need of low steam.

The drum level will be derived from up to three freelancetransmitters and is density remunerated for pressure among the boiler drum. This is the process which removes the oxygen form water and the other gases like carbon dioxide and other no condensable gases from feed water and by doing this is the reducing of the corrosion in the parts of the boiler and equipment longevity and safety of operation.

Deaerations are of two type viz. Mechanical deaeration and chemical Deaeration. The Henry's Law of physics that works in the Mechanical deaeration .In Deaeration before feeding water to the boiler the dissolved gasses in the water is removed .usually the oxygen and the carbon dioxide are present in the water which is natural and those gases are of more concern to the steam plant operation. The gasses present in the untreated water oxygen and carbon dioxide cause the steam plant material to corrode. And the rate of corrosion is directly proportional to the amount of gasses present in the water and as the heat increase any reactions multiply and accelerate the rate of the reaction.

Upgrading control

Due to the quality and importance of economical boileroperation, one variety of update that sometimes pays high dividends may be a system upgrade. Today's advanced boiler automation and combustion system square measure capable of reducing price whereasproviding resources for larger flexibility within the plant management and management. Boiler steam masses square measure invariably unsteady and today's subtle system will mechanically observe changes and answer conditions quicker and a lot of accurately than operated by hand devices.

Boiler potency, within the simplest terms, represents the distinction between the energy input and energy output. To attain optimum potency, operators usually try and run boilers at more or less eighty p.c. load. In application with multiple boilers and variable masses, achieving the foremost economical combination of boilers might mean sometimes motility down some to permit others to work at a harder firing rate. One effective strategy in periods of sunshine production demands is to possess your less economical boilers operate in standby mode and interact a lot of economical boilers to satisfy the load necessities. This will be accomplished by programming the boilers system to mechanically manage the required boilers reverse sequence. The controls should be properly adjusted and coordinated for continues delivery of steam or quandary to those dynamics processes. This includes on-line operation moreover as management and observance of burner start-up and ending sequences. Boilers control methods can improve operational consistency and reliability and protect against damage to combustion process equipment and surroundings areas due to other undesirable events. Following are some advance control techniques.

Minimize excess air – economical operation of any combustionequipment’s is very enthusiastic about a correct air-to-fuel magnitude relation. The quantity of turn fuel and excess air within the exhaust is a sign of a burner’s combustion potency and needs energy to heat and move excess air. In actual operation, boilers and different fuel burning systems don't do an ideal job of blending the fuel and air, even below the most effective potential condition.

Regular of stack gas oxygen content can indicate what quantity excess air (O2) is accessible within the stack gas once the fuel/air combustion. High levels of O2 within the stack gas are corrected by incorporating as excess air trim loop into the boiler controls. A stack gas oxygen instrument is put in to ceaselessly monitor excess air and change the boiler fuel-to-air magnitude relation for optimum potency. The reduction of excess air within the boiler combustion method provides a far better heat-transfer rate, advanced warning of potential flue gas issues and considerably lower fuel prices. By reduction the quantity of air inquiring the combustion chamber, the boiler is in a position to soak up additional of the warmth within the method. Since the proportion of oxygen in exhaust stack is closely concerning the quantity excess air, by adding oxygen trim controls, operators have tighter management over flue gas emission, additional precise management of excess air to oxygen point, and quicker come to line purpose following disturbances.

Plants that use a jackshaft (single purpose positioning),parallel positioning or different automatically coupled system will gain important blessings by changing to a cross-limiting, absolutely metered combustion management strategy. This management methodology helps improve safety by minimizing the possibility of a dangerous ration air and fuel inside a combustion method. This can be enforced by perpetually raising the air flow before permitting the air flow to drop. Cross-limiting combustion management is very effective and might simply provide: higher improvement of fuel consumption, safer operative condition by reducing the chance of explosion; quicker combustion characterization setup; improved cosmology and troubleshooting; and higher method visibility. Combining firing of multiple fuels at the same time may also be simply accomplished inside this sortof system.

Environmental Reporting the easy way

As well power plant operators know, the EU directives environment performance will tighten in the future and palace more demands on emission monitoring. However, with the help of modern automation, this will not be problem. Online emission management application, such as Emission Monitoring and Reporting Solutions, provide production plants with real time information about current emission levels and limit excesses, and forecast the flue gas emission, making it possible to react proactively to potential problems on time. The solutions fulfil the requirements of the EU directives for large combustion plants and waste incineration, thus also enabling effective authority reporting.

Better performance through optimization

Getting the foremost out of warmth and/ or electricity production over the whole plants cycle is actually on the terribly high of each power producer’s priority list. It’s potential by putting in advanced method management applications.

Stable and economical combustion may be a primary demand for winning boiler operation. Variable combustion condition and fuel quality along with ever-changing hundreds upset combustion. As a result, boiler potency decreases, and flue gas emission additionally as flue gas oxygen content increase. By optimizing combustion \, it's potential to manage the combustion method against variations in production, fuel quantity& quality and combustion circumstances. It stabilizes the combustion method, improves boiler potency additionally as minimizes flue gas chemical element content, nor emissions and greenhouse emission emissions.

Another challenge at plants is usually the way to specifically live the standard and quantity of solid fuel fed to the boiler. Typically, solely the conveyor speed is employed as a measure for fuel power. A Fuel Power Compensator application with that it's attainable to compensate the disturbances within the fuel enclose order to stabilize combustion and steam production. It’s used on the fuel enclose order to stabilize combustion and steam production. It’s supported the estimation of the fuel power (fuel energy input to the boiler). Quick and correct estimation iscreatedwith a mixture of boiler balance calculations and element consumption calculation.

Perfect match: || Automation and Equipment ||

Working plant automation builds on advanced solutions that everyone link along dead. However to confirm the foremost economical overall plant performance, automation should be well-integrated into the plant instrumentation. Anideal match brings the most effective results.

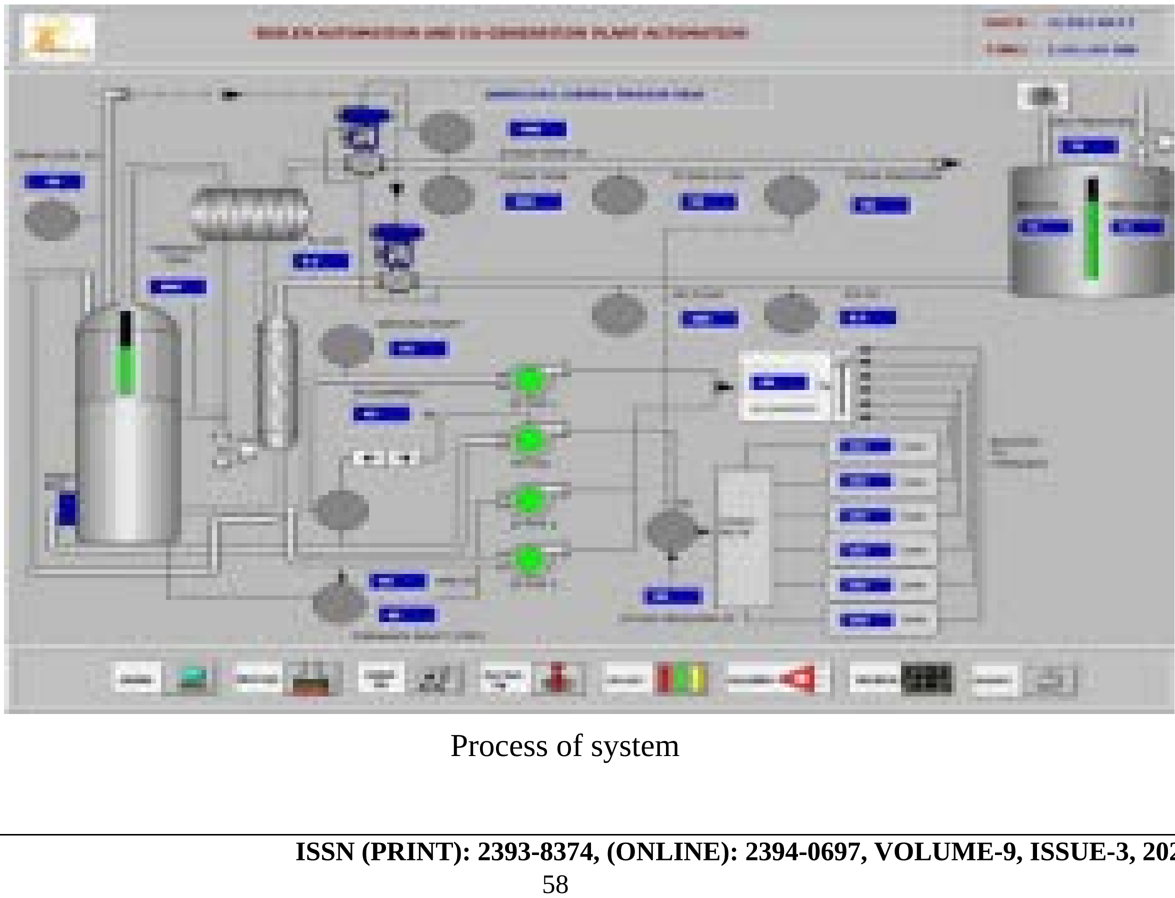
Whether you are buildings a Greenfield plant or modernizing an existing one, it is always a major project with lots of **Equipment suppliers** – who are perhaps not able to see the big picture. The main automation system in BOILER Automation covers the whole process, including the boiler islands, turbine islands, balance of plant, fuel handling and auxiliary processes. A huge advantage for the plant is if there is one source that can offer a complete delivery from handling to the tip of the smokestack.

And the Future?

Automation nowadays is taking part in a serious role altogether Production plant’s operation. However so much can the events go? What might the automation level be, let’s say in 2050?

“I assume there'll show discrepancy varieties of inexperienced or greener energy offer processes connected to the common district heating/cooling networks and national’s grids. They’re going to be controlled optimally and operated and remotely with advanced automation solutions.”

“The power plants can run with biomass, solar power, process heat, biogas, waste-to-energy, wind, heat pumps, fossil fuel, energy storages, chemical process or coal with carbon capture. Automation’s role is to require care of the optimum power and warmth production supported capabilities and prices.”



Process of system

Analog input Analog output

STARTUP PROCEDURE:

- Ensure the boiler feed water quality is meeting the norms (pH- 8.5 to 9.5, TDS - LT; 50 ppm, TH - LT; 5ppm).
- While filling the boiler feed water tank, ensure the dosing chemicals tank level and dosing pump operation for pH booster, Oxygen scavenger and Antiscalent.
- Ensure that the feed water tank level (30KL) Min. level of 60%.
- Ensure that the feed pump suction strainer cleaned and ensure the suction and discharge valve opencondition.
- Put ON the main electric switch and ensure that 3-phase power supply is available.
- Ensure power supply to HMI & it is in ON position. Select water pumps No. 1 or No. 2 in HMIpanel.
- Ensure no water in the boiler drum. Select the FILL AND FIRE Switch in FILL position to start thefeed pump for filling the water in the boiler drum and while run the feed water pump water
- Level starts rising in boiler drum. Water pump indication will be ON. After reaching working levelwater pump will stop and indication will turn to OFF. Open the air vent valve. Put switch in FIRE position.
- NOTE: The vent valve should be closed only after steam starts coming out.
- Close the main steam valve.
- Ensure the water level in boiler drum is between 25% to60%.

Ensure sufficient quantity (About 9MT) of Briquettes in fuel bunker.

- Ensure that all dampers are in 100% open condition from shell outlet to ID fan suction and ensurethat ICBD is closed i.e. Cyclonal in line.
- Start all RALV's in flue gas path.
- Pour about 50kg of diesel soaked solid briquettes in moving grate floor.
- Ignite the fuel and watch the flame. Furnace pressure to be maintained 0 mm WC while starting to enhance the effective flame.
- After healthy flame picking up, start the ID fan, PA and SA fan on sequence order.
- Start the moving grate at 16Hz and start the fuel feeders at 50% VFD and screw conveyors at

- 2Hz to gradually feed the crushed briquettes into the furnace.
- Gradually increase the fuel feeding rate and increase the FD air by opening the damper
- (Up to 16 Hz) accordingly.

- After reaching boiler steam pressure at 2.5 kg/cm^2, boiler vent valve shall be closed.
    - After reaching boiler steam pressure 9 kgcm^2, to be informed to end users and gradually open mainsteam valve, HP steam valve and LP steam valve. (Note: Pressure settings (H.P and L.P) will bechanged as per the requirement from the user.)
    - Record the boiler steam high pressure alarm and tripping pressure if required.
    - Check the drum level and give the IBD blow down at regular interval to maintain the TDS below3000 ppm.

RUNNING ATTENTION:

- It is advisable to the operator, to make it a practice to go around the boiler and check the Following points periodically. Check the Boiler drum level in the gauge glass and the level shall be maintained not less than 60 % of the gauge glass. If the level falls less than 60 %, check the feed pump operation and mobrey function. Drain the Boiler drum level gauge glass once in a shift and ensure the water level.
    - Boiler feed water, condensate water, make up (RO) water and boiler blow down water is checkedafter every four hours of boiler operation or more frequently. If abnormal is found, ensure the Chemical dosage and control the dosing accordingly to the parameters.
    - Check and ensure no excessive / abnormal noise is coming from rotary equipment.
    - Check and ensure all valves and joints are leak proof.
    - Check and ensure no part of boiler body is getting overheated.
    - If the water pump is working on-off so as to ensure the functioning of Mobrey level control
        - Switches or control valve and it should be ensured that proper water flow is maintained.
        - Check and ensure the exhaust from the chimney is normal.
        - Check and ensure no sparking or loose contact is there in the electric circuit.
    - Check and ensure all the controls and safety devices are working satisfactorily.
    - Check and ensure a steady steam pressure and water level is maintained within desired range ismaintained.
    - Check and ensure no over firing of fuel is being done.

- Blow down the boiler at regular intervals. The blow down frequency will depend upon the qualityof water being used for the boiler. Regulate the continuous blow down quantity according to theTDS in water.
    - Drain the Mobrey level switch and the gauge glasses once in a shift.
    - Keep a record of stack temperature and SPM readings.
    - Maintain furnace draught between -1 to -5 mm WC.
    - Ensure that the stack temperature is within desired range for given load. If higher, check for foulingof heat transfer surface or blockage of flue gas passage. Clean the boiler smoke tubes on need basisor during preventive maintenance.
    - Check and maintain motor currents for FD fan, ID fan, pump etc.
    - The unburnt in the ash should be less.

- Ensure that no air infiltration in flue gas passage is taking place.
- Check for uniform combustion all over the bed.
- Ensure that all reading (and abnormalities) are recorded correctly in log book, including chemicalcharges, blow down etc.
- Ensure that all the maintenance instructions are followed religiously.

STOPPING PROCEDURE:

- To be informed to end user before stopping the boiler.
- Stop fuel (briquettes) supply to the grate.
- Adjust the moving grate speed and let the remaining fuel burnt out as soon as possible.
  - After about 2-3 hours when all slag of the grate is fallen of the slag inside of slag equipment should be removed, and stop forced fan and induced draft fan, open front air dampers and ash falling doors to make natural ventilation.
  - The main steam stop valve closed.
  - After burning stops, the grate should be continuously operated until the temperature inside offurnace is to be cooled down below 150°C.
  - After reaching 2.5 kg/cm 2 boiler vent valve shall be opened.
  - The Emergency shutdown of the grate will be carried out based on the following procedure:
  - Stop fuel to the grate.
  - The Moving grate speed to be reduced until all slag has been fallen off and then the grate canbe stopped.
  - Before the furnace being cold down a mechanized draft should be maintained.
  - Allow the fuel inside the moving grate to burn off completely.
  - Blow down the boiler, Membrane panel header, Mobrey level switch and gauge glasses under
- Pressure (5 kg/cm 2). The blow down should be such as to maintain a TDS in the boiler to lessthan 3000 ppm.
  - It takes about 2 hours to cool down the furnace and steam generating section.
- Close the valve, the feed water inlet line to the boiler and main steam stop valve.
- Note: Never permit the water to disappear from the gauge glass when routine blow down is done
  - Isolate boiler control panel by putting OFF all electrical supply from MCC.Clean the boiler and its surroundings off any dripped oil, water etc.

Operating Instruction to Operator;

To design a system using Programmable Logic Controller with the specifications given: here are four LEDs red, green, yellow and blue. Two push-button switches are there for START, STOP and for LED selection there is SELECTswitch.

The START button is pressed after that:

1. Condition 1: If SELECT switch is pressed once then red LED glows.
2. Condition 2: If SELECT switch is pressed twice then green LED glows.
3. Condition 3: If SELECT switch is pressed thrice then yellow LED glows.
4. Condition 4: If SELECT switch is pressed four times then blue LED glows

FUTURE SCOPE

1. This project can be implemented practically when SCADA is connectedwith PLC. More enhanced features can be added up to it. For e.g. reverseOsmosis purification system can be added.
2. The project based on sewage can be extended to water purification systems, oil refinery systems in industries.
3. The project can also be extended to packaged drinking water industrieswhere water is first purified, then filled into bottles, capped, labelled and then sold in bottles.

RESULTS

Interlocks and protection

A Boiler Interlock & protection is a system that monitors the safe running state of a boiler operation and if the state becomes unsafe the interlock will trip the boiler to prevent unburnt fuel from entering the furnace. Due to advancement of technology, existing system should be revised with intelligent system. Various alternative measures were described to mitigate the problems presented. New generation of pulverized coal fired boiler technology is currently under development which will permit generating efficiencies in excess of 42%. Design improvements which target reduced emissions and expanded operability, and explores some of the boiler design implications for the ultra-supercritical conditions needed to achieve the high cycle efficiencies for the future.. Furnace safeguard supervisory system (FSSS) play an important role in protecting the boiler of thermal power plant from danger. In order to evaluate the performance of FSSS itself, functional safety theories are applied in this paper to achieve hazard and risk analysis, target safety integrity level (SIL) determination and functional safety evaluation. The most important safety instrumented function (SIF) of FSSS-master fuel trip (MFT) is considered, and the probability of failure on demand (PFD) is calculated based on the method of fault tree analysis (FTA).

Design of sequence control for boiler ignition and blast-furnace gas, the logic design of Master Furl Trip (MFT) and Flame Detection.. Efficient management of process system can lead to fuel savings, improved process efficiency, lesser operating and maintenance cost, and greater environmental safety. With the growing need for energy conservation, most of the existing process systems are either modified or are in a state of modification with a view for improving efficiency. Any new proposal for improving the efficiency of the process or equipment should prove itself to be economically feasible for gaining acceptance for implementation.

Hazards present in the project. Risk analysis involves the identification and assessment of risks to the population exposed to hazards present. This requires an assessment of failure probability, credible accident scenario, vulnerability of population etc. Much of this information is difficult to get or generate consequently, the risk analysis in present case is confined to maximum credible accident studies and safety and risk aspect related to proposed grain based distillery and Co-Generation power plant. Risk assessment involves the following:

AUTOMATION IMPACTS:

By introduction of Automation in boiler operation, the following are the impacts,

1. It increases productivity and reduce cost.
2. It gives emphasis on flexibility and convertibility of manufacturing process. Hence gives manufacturers the ability to easily switch from manufacturing Product A to manufacturing product B without completely rebuilt the existing system/product lines.
3. Automation is now often applied primarily to increase quality in the manufacturing process, where automation can increase quality substantially.
4. Increase the consistency of output.
5. Replacing humans in tasks done in dangerous environments.

ADVANTAGES OF AUTOMATION:

1. Replacing human operators in tasks that involve hard physical or monotonous
Work. Also task done in dangerous environments.
2. Performing tasks that are beyond human capabilities of size, weight, speed,
Endurance, etc.
3. Economy improvement: Automation may improve in economy of enter-
Prises, society or most of humanity.

DISADVANTAGES OF AUTOMATION:

1. Technology limits: Current technology is unable to automate all the de-
Sired tasks.
2. Unpredictable development costs: The research and development cost ofAutomating a process may exceed the cost saved by the automation itself.
3. High initial cost: The automation of a new product or plant requires ahuge initial investment in comparison with the unit cost of the product
4. Replacing humans in tasks done in dangerous environments.

With introduction of Automation in boiler and process, minimise the error by Alarming System. It helps to investigate the error, Lot of interlock to introduce to mitigate the risk in the boiler operation and safety to operator and reduce the impact on environment.

CONCLUSION

With the speed of changing technology today it is easy to lose sight or knowledge of the basic theory or operation of programmable logic. Most people simply use the hardware to produce the results they desire. Hopefully, this report has given the reader a deeper insight into the inner workings of programmable logic and its role in mechanical operations. The idea of programmable logic is very simple to understand, but it is the complex programs that run in the ladder diagrams that make them difficult for the common user to fully understand.

Hopefully this has alleviated some of that confusion.SCADA is used for the constructive working, using a SCADA system for control ensures a common framework not only for the development of the specific applications but also for operating the detectors. Operators experience the same "look and feel" whatever part of the experiment they control. However, this aspect also depends to a significant extent on proper engineering.

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