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RESEARCH ARTICLE

Implementation of Pssr As a Constituent of PSM to Enhance Occupational Safety

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Kata Kunci:
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Abstrak

Industri proses berisiko tinggi melibatkan pengelolaan zat berbahaya, yang dapat menyebabkan insiden keselamatan jika tidak dikelola dengan benar. Penelitian ini bertujuan untuk menilai dampak dari Pra-Startup Safety Review (PSSR) pada peningkatan keselamatan kerja di PT X sebagai komponen kerangka Manajemen Keselamatan Proses (PSM). Pendekatan yang diambil bersifat deskriptif kualitatif, menggunakan metode studi kasus yang mencakup tinjauan dokumen internal dan wawancara dengan pemangku kepentingan terkait. Temuan mengungkapkan bahwa sementara sebagian besar peralatan penting telah diperiksa dan dikonfirmasi sebagai siap beroperasi, ada masalah operasional yang sebelumnya diabaikan, seperti kebocoran di jalur BFW dan kegagalan di NG PCV, yang mengakibatkan penundaan dalam proses. Ini menyoroti perlunya tinjauan yang lebih menyeluruh terhadap daftar periksa PSSR untuk memastikan semua masalah potensial diidentifikasi sebelumnya. Singkatnya, efektivitas PSSR di PT X dapat ditingkatkan melalui peningkatan pengawasan dan tindak lanjut atas setiap masalah yang diidentifikasi selama fase startup.

***Key Word**:*
Pre-Startup Safety Review, Process Safety Management, Process Safety Incident.

Abstract

High-risk process industries involve the management of hazardous substances, which can lead to safety incidents if not appropriately managed. This research aims to assess the impact of the Pre-Startup Safety Review (PSSR) on improving occupational safety at PT X as a component of the Process Safety Management (PSM) framework. The approach was descriptive qualitative, using a case study method that included internal document review and interviews with relevant stakeholders. The findings revealed that while most critical equipment had been inspected and confirmed as operationally ready, operational issues were previously overlooked, such as leaks in the BFW line and failures in the NG PCV, which resulted in delays in the process. This highlights the need for a more thorough review of the PSSR checklist to ensure all potential issues are identified in advance. In summary, the effectiveness of PSSR at PT X can be improved through increased monitoring and follow-up of any problems identified during the start-up phase.

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INTRODUCTION

The process industries manage many hazardous, flammable and explosive substances, and the methodologies used to supervise these materials tend to be highly specialized. The sector faces significant risks if safety is not effectively overseen. A process safety incident is one of the most dangerous threats, which can lead to catastrophic results. Such incidents involve releasing or losing hazardous substances that can result in extensive health and environmental impacts. Rialivhuwa Nekhwevha (2019) noted that most process safety incidents within the chemical sector occur during plant start-up and shutdown phases. This is mainly due to the emergence of more hazards during these periods than standard plant operations. In addition, many organizations often fail to learn lessons from past incidents in their operations or those experienced by other entities. Failure to learn from previous incidents increases the likelihood of similar occurrences in the future. Therefore, companies must emphasize safety analysis during this vital stage to reduce risks and prevent the recurrence of accidents.

A poignant illustration of a breakdown in process safety management occurred on Mar. 23 2005, at BP's Texas City refinery. On that day, a powerful explosion struck the refinery, resulting in the death of 15 people and injuring 180 others. The incident was triggered by an overflowing isomerization unit explosion drum, which caused a hydrocarbon release that was then ignited by a heat source, causing a massive explosion and pool fire. Three independent investigation panels were formed, and they generally agreed that the accident stemmed from a combination of factors, including design and operational weaknesses, technical issues, organizational challenges, and a lack of safety culture. This incident emphasises the critical need for

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effective safety management, especially during the start-up and shutdown phases.

This disaster highlights the need for a robust and sustainable safety management system, especially in managing critical phases such as plant start-up and shutdown. An effective safety management system must identify, assess and control the hazards that arise in these phases, which often carry more significant risks than regular operations. Process Safety Management (PSM) has emerged as a key strategy adopted in various industries to address these risks. PSM concentrates not only on worker protection but also on process risk management. The goal is to prevent or reduce the impact of toxic, reactive, flammable, or explosive chemical releases that may occur in operations involving any of the 137 hazardous chemicals.

A critical aspect of Process Safety Management (PSM) is the Pre-Startup Safety Review (PSSR), which entails a thorough examination and assessment of equipment modifications before operations begin, ensuring that these changes have been implemented according to approved design specifications and that appropriate procedures have been established and are adequate and that training for relevant personnel has been completed. The main objective of PSSR is to offer a clear, organized and straightforward approach to guarantee that all potential risks, whether previously recognized or yet to be identified, have been adequately addressed and resolved before the commencement of operations. PSSR is conducted to confirm that all critical aspects of process safety management have been adequately addressed and that the facility is safe for operational commencement. This process minimized the likelihood of system failure, allowing the plant to operate safely and effectively. This research aims to assess the effectiveness of PSSR in strengthening occupational safety. It is essential to understand how the implementation of PSSR is improving occupational safety at PT X so that it can contribute to this improvement.

METHOD

The research approach used in this study is a qualitative descriptive method featuring a case study framework. This investigation was conducted at PT X, aiming to assess the Pre-Startup Safety Review (PSSR) implementation as an integral component of the company's Process Safety Management (PSM) system. Data was collected through two main techniques: document examination and interviews. Document inspection entailed a comprehensive analysis of the company's internal documents, including PSSR procedures, PSSR reports, checklists, and records related to PSSR implementation. Furthermore, interviews were conducted with individuals directly involved in the PSSR process to gain deeper insights into the effectiveness of its implementation. The data collected was then subjected to qualitative analysis to evaluate the extent to which the implementation of PSSR can improve work safety at PT X.

RESULT AND DISCUSSION

Pre-Startup Safety Review (PSSR) Procedure

PT X has implemented the PSSR procedure, a crucial measure in preventing occupational accidents and environmental contamination. This procedure is particularly important before the resumption of production activities, whether after construction, modification, or substantial upgrades to the facility. It was established to prevent failures during the startup phase, which could potentially result in these serious outcomes. The implementation of PSSR procedures covers a variety of important elements, including the purpose, scope, and responsibilities of those involved in the process. PSSR procedures are designed to prevent failures during the startup process of new plants or production sites, and alterations or expansions of existing facilities. Its execution is critical, especially after shutdowns or significant upgrades such as turnarounds. The main objective of the procedure is to prevent occupational accidents, incidents related to process safety, equipment failure, and environmental degradation. The scope includes the entire process of construction, modification, or upgrading of production facilities that significantly affect operations.

In its implementation, the PSSR procedure at PT X highlights the need for careful verification of the completeness of construction, equipment, and operational protocols when hazardous chemicals are integrated into the production process. Any recommendations arising from the Process Hazard Analysis (PHA) must be addressed before startup begins, underscoring the importance of this verification process in mitigating potential risks associated with hazardous chemicals, especially in newly established or modified facilities. The PSSR procedure specification entails various phases, from preparation for startup to document validation. These phases include the completion of readiness checklists by accountable AVPs and VPs, generation of punch lists, field verification to confirm equipment condition and collection of supporting documents. Subsequently, these documents are submitted to the VP to approve the PSSR checklist's completeness. Once all phases are completed, the SVP of Plant Operations endorses the PSSR report and initiates the facility's transition from the maintenance team to the operations team, followed by a final assessment of the punch list as part of the continuous safety improvement initiative.

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The PSSR procedure implemented at PT X generally consists of essential elements aligned with applicable industry standards and regulations, as specified in Law No. 1 Year 1970 on Safety Regulations and Work Enforcement No. 50 Year 2012 on the Implementation of Occupational Safety and Health Management System (SMK3). This procedure adheres to the basic principles of work safety by involving various stakeholders in verifying equipment readiness and assessing completeness before process startup, serving as a preventive measure against accidents. In addition, this procedure is in line with international regulations, specifically the Occupational Safety and Health Administration (OSHA) Regulation (Standard - 29 CFR) Process Safety Management of Highly Hazardous Chemicals - 1919.119, which mandates the conduct of a process hazard analysis and safety verification before resuming operations of facilities involving hazardous chemicals. Through this initiative, PT X has reaffirmed its dedication to complying with national and international safety standards while improving operational preparedness to mitigate risks associated with process safety incidents.

Implementation of Pre-Startup Safety Review (PSSR) on Coal Boiler Unit 1 at Plant 6

Boilers operate by burning coal fuel inside a closed vessel to produce steam. This vapour is then used to power a generator turbine, which produces electricity. Because the boiler functions under high pressure and temperature, with flammable fibres involved, it presents considerable potential risks. The possibility of explosion, steam leakage, or fire due to system malfunction increases significantly if operational safety measures are not properly implemented. Failure to conduct a Pre-Start Safety Review (PSSR) could lead to catastrophic accidents, significant financial losses, and damage to the environment. Therefore, the PSSR is not just essential but a critical step to guarantee that all safety standards are met before the boiler begins operation, thereby minimising the likelihood of accidents and protecting workers and the surrounding environment.

During the execution of the PSSR, a checklist acts as a fundamental tool to ensure that each critical component has been carefully examined before starting the start-up procedure. This checklist covers various vital elements essential to ensure personnel safety and the plant's operational reliability. Below is a table displaying the critical items that have been reviewed in the PSSR, which will be further analysed to evaluate the readiness of the facility for operations:

Tabel 1. Main Checklist PSSR Boiler Batu Bara 1

Job description TA Coal Boiler 1			New Facilities Modification Significant (TA)		improvement
Plant: Factory 6			Area : Coal-fired boiler 1		
CHECKLIST					
A. PROCEDURE/DOCUMENTATION					
INSTRUMENT					
1	Interlock test procedure and results (Loop dan interlock/permissive/alarm testing)	√	Yes	No	N/A
2	Instrument calibration was completed and documented	√	Yes	No	N/A
3	Work on the control valve has been fully completed	√	Yes	No	N/A
4	Is there an abnormality in the control valve, such as leakthrough? If yes, please specify the control valve item and explain the consequences. (The problematic control valve has been repaired and completed. It will be monitored during startup when the valve is filled in during the process)	√	Yes	No	N/A
5	Pressure/temperature/level gauges, flowmeters, transmitters, sensors and other instrument equipment have been installed correctly and have been assured to function properly within their operational range.	√	Yes	No	N/A
Note : 1. Attached is the interlock & instrumentation equipment calibration list (to follow with the TA report) 2. All control valves have been checked and repaired, and adjustments at startup will be made later 3. All instrumentation is properly installed and confirmed to function properly					
ELECTRICITY					
1	Lighting on the panel is sufficient	√	Yes	No	N/A
2	Access to the panel and cleanliness in the panel area are maintained neatly	√	Yes	No	N/A
3	Supporting facilities are available to protect outdoor panels (canopy, junction box or similar). Additional Mica plastic cover on the Panel and Junction Box	√	Yes	No	N/A
4	Cables in tidy condition in the Motor area that were repaired as per WO	√	Yes	No	N/A
5	No damage to the cable gland.	√	Yes	No	N/A
6	Continuity tests have been conducted with good results.	√	Yes	No	N/A
7	The Grounding system is functioning properly	√	Yes	No	N/A

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Job description TA Coal Boiler 1			New Facilities Modification √ Significant (TA) improvement				
Plant: Factory 6			Area : Coal-fired boiler 1				
CHECKLIST							
	Measurements have been made by looking at the grounding resistance value (6 of 29 points not found)						
8	The electrical installation has been inspected by the K3 Electricity Officer and is functioning properly. Conducted by Internal Parties	√	Yes		No		N/A
9	Lightning conduit installation has been inspected, and the results are known by AK3 Electricity, and IPP is functioning properly. Grounding measurement performed	√	Yes		No		N/A
10	Certification of lightning conductor installations has been carried out. (measurements have been carried out by a third party, and the results are in accordance)	√	Yes		No		N/A
11	Lock out and tag out on the power source have been normalized. For LOTO release, adjust to the Operation at start-up	√	Yes		No		N/A
Note : 1. Continuity & simulation control has been done (found in the Electricity TA Report) 2. Grounding Check Result 3. Inspection Result of Lightning Conduit Installation							
INSPECTIONS							
1	Pressure reliefs have been inspected, tested, and are functioning properly. (list attached)	√	Yes		No		N/A
2	The repaired pipeline has been inspected (by leak test/hydro test or another method) and is functioning properly. The pipeline was not included in the inspection items in TA BB1. Still, a hydro test was carried out on the Furnace, Steam Drum, Economizer, Superheater, Screen, & Superheater Coil, with the result that there were no leak findings		Yes		No	√	N/A
3	Vapour aircraft have been inspected and tested and are in good working order.	√	Yes		No		N/A
4	Pressure vessels have been inspected and tested and are functioning properly.	√	Yes		No		N/A
5	All equipment with rotating parts has been inspected and is functioning properly according to the direction of rotation of the equipment..	√	Yes		No		N/A
6	The steam and pressure vessel certification programme has been conducted. Not done because certification is still valid		Yes	√	No		N/A
7	A production personnel aircraft certification programme has been conducted. If applicable, please specify the item number.		Yes		No	√	N/A
8	Has the radioactive source as the level indicator been reinstalled, and is it in a safe condition?		Yes		No	√	N/A
Notes:							
ENGINEERING: Modifikasi, Management Of Change dan Replacement In Kind							
1	All new tool additions or modifications have been made to MOC documents.. Attach documents: 1. Addition of 1-inch demin water tap point on downstream PI-225 & PI 325 PI 225 has been done & PI 325 is waiting for the implementation of TA BB2 2. Valve MOV-211 A&B and MOV-311 change from welding joint to flange to flange MOV 211 has not been carried out because the material did not pass QC, and MOV-311 A&B has not been carried out, waiting for the implementation of TA BB2 3. Replacement of the expansion joint line for secondary air distribution to the furnace from the welding joint to the flange. Ok 4. 4. Replacement of recycled fan unit from vertical model to horizontal model (upgrade model by manufacture) and modification of foundation to adjust outlet flange (24-K-203C) Already installed 5. Changes in the internal structure of the deaerator and demister filling to random packing. – ok, Sirkuler TTD 6. Addition of resin catcher strainer to the inlet bypass line of the T-611 demin tank - Ok 7. Changing the weld tag to the threaded type on the air cap distributor furnace as many as three ea	√	Yes		No		N/A

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Job description TA Coal Boiler 1			New Facilities Modification √ Significant improvement (TA)			
Plant: Factory 6			Area : Coal-fired boiler 1			
CHECKLIST						
	Already installed 8. Addition of drain valve for internal deaerator cleaning facility with downstream that can be fitted with hose Already installed 9. Addition of water service line to coal feeder area of Boiler BB 1 Already installed					
2.	PHA (HAZOPS/Checklist/What if/FMEA/etc) has been created and is still relevant/valid? Modifications are not significant. a. Addition of a 1-inch demin water tap point on the PI-225 downstream b. Changes in the internal structure of the deaerator and demister filling to random packing c. Addition of a resin catcher strainer on the bypass inlet line of the T-611 demin tank d. Changes in the weld tag to a threaded type on the furnace distributor air cap e. Addition of a drain valve for an internal deaerator cleaning facility with a downstream that can be fitted with a hose	√	Yes	No		N/A

3.	All recommendations in the PHA Action Sheet have been implemented.
	Attach the PHA Action Sheet form
	a. Addition of 1-inch demin water tap point on downstream PI-220) // Installation of Threaded Pipe Cap on tap point if the line is no longer used – Ok
	b. Change of internal structure of deaerator and demister filling to random packing) // N/A
	c. Addition of resin catcher strainer on demin tank inlet bypass line T-611) // Addition of pressure difference indicator (PDI) on bypass line 6 unch – ok & strainer cleaning program once a week every Friday (OPERATING PIC)
	d. Change of weld tag to threaded type on furnace distributor air cap) // N/A
		√	Yes	No		N/A

4.	Relevant Operational Manual/Work Instructions are in place/reviewed?		Yes	No	√	N/A
5.	Relevant Maintenance Manual/Work Instructions are in place/reviewed?		Yes	No	√	N/A
6.	Process drawings such as P&ID, PFD or Isometric Drawing have been updated? a. Changes to MOV-211 A&B and MOV-311 valves from welding joint to flange to flange (I/P by Rekons) b. Replacement of expansion joint line for secondary air distribution to furnace from welding joint to flange to flange (I/P by Rekons)	√	Yes	No		N/A
7.	Mechanical drawing has been updated?		Yes	No	√	N/A
8.	Electrical drawing has been updated?		Yes	No	√	N/A
9.	Classification of electrical equipment and installations is in accordance with NFPA/NEC/IEC/IEEE/SPLN(PUIL) standards?		Yes	No	√	N/A
10.	Lock-Out Procedure has been updated?		Yes	No	√	N/A
11.	Catalyst/chemical loading materials and procedures are by the process specification design and procedures		Yes	No	√	N/A
12.	MSDS sheet is available? Random packing deaerator crosscheck filling (Attached)	√	Yes	No		N/A
13.	The primary and supporting equipment (gaskets, covers, seals, etc.), both new and repaired, are by process specifications	√	Yes	No		N/A
14.	Training for Operators is conducted? The addition of a resin catcher strainer on the bypass inlet line of the T-611 demin tank) will be scheduled for knowledge sharing at the end of March at the latest.	√	Yes	No		N/A
15.	Training for Supervisors conducted?		Yes	No	√	N/A
16.	Training for Maintenance personnel conducted?		Yes	No	√	N/A
17.	Training for Fire/Emergency Response conducted?		Yes	No	√	N/A
18.	Training for Contractors conducted?		Yes	No	√	N/A
Notes :						
MECHANICAL						
1.	All installed gaskets are by the drawing. Mention if any gaskets are not in accordance.	√	Yes	No		N/A
2.	Adhering to the standard in all bolt fastenings is crucial, as it guarantees safety and reliability in the equipment's operation.	√	Yes	No		N/A
3.	All covers or guards on rotating parts have been reinstalled.	√	Yes	No		N/A
4.	All equipment with rotating parts has been properly installed by the direction of	√	Yes	No		N/A

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Job description TA Coal Boiler 1			New Facilities Modification √ Significant improvement (TA)		
Plant: Factory 6			Area : Coal-fired boiler 1		
CHECKLIST					
rotation of the equipment as it should be.					
5. All installed blinds have been re-normalized to their start-up positions. Attach blind list.	√	Yes	No		N/A
6. Installation of masking tape on flanges/connections of explosive/toxic gas fluid pipes that are dismantled during repairs/maintenance.		Yes	No	√	N/A
7. The equipment has been properly lubricated.	√	Yes	No		N/A
8. Equipment that requires lube/seal oil in regular operation has been filled with lube/seal oil that meets the equipment standards. Attached is a comprehensive list of equipment, providing a clear overview of the maintenance activities..	√	Yes	No		N/A
9. There is no residual oil, seepage, dripping, or spills of oil around or on equipment insulation (pump turbines, compressors, and others).	√	Yes	No		N/A
10. Lube/seal oil is available in the equipment area and is stored and labelled correctly and according to labelling standards. Only Lube Oil is available on the equipment	√	Yes	No		N/A
11. The drive belt/chain is installed correctly.	√	Yes	No		N/A
Notes: 24-E-201, there are three ea modifications from reliability; the previous cap was welded and replaced with a thread for installation					
WELDING & PIPING					
1. All equipment, piping and connections have been adjusted/augmented by normal operating conditions.	√	Yes	No		N/A
2. All equipment and piping related to welding has been ensured to have been welded with strict adherence to standards and recommendations, instilling confidence in the safety of the equipment.	√	Yes	No		N/A
3. All equipment/piping that has been painted has been done properly by standards and recommendations	√	Yes	No		N/A
4. All platform gratings, handrails, stairs or other facilities that were removed/cut have been reinstalled/welded correctly and according to standards.. a. Handrail on the 2nd floor for access to modify the air distribution line to the furnace – ok, b. Handrail on floor 2.5 for access to coal feeder line entry work – ok	√	Yes	No		N/A
5. All reinforcing pads, skirts, base plates, legs, pipe supports, hangers and other supporting equipment are installed correctly and securely.	√	Yes	No		N/A
6. All scaffolding or other temporary access no longer used has been dismantled and removed from the plant equipment area. a. Floor 6 near PSV 202 still has stacks of scaffolding – Ok b. Floor 4 wall tube side towards cyclone still has scaffolding – Ok c. Scaffolding material on floor five superheater – Ok	√	Yes	No		N/A
Notes:					
OPERATIONAL					
1. Create a punch list item for start-up preparation. Attached is the punch list item form.	√	Yes	No		N/A
2. All punch list items for start-up preparation have been followed up. Attached is the punch list item form.	√	Yes	No		N/A
3. There is a start-up checklist for operators. Attached is the start-up checklist form.	√	Yes	No		N/A
4. Is there any interlock that is bypassed? If so, please state the interlock ID number along with the consequences. a. TALL-202 I, J, K, L Temp Low – Low Furnace Indication (Temporary for start-up purposes) → Coal feeder cannot run b. TAHH-202 I, J, K, L Temp High-high Furnace Indication (Temporary for start-up purposes) → Coal feeder cannot run c. PALL 236 D, E, F Pressure Low-Low Furnace (Temporary for start-up purposes) → Boiler trip d. PAHH 236 A, B, C Pressure Furnace High-High (Temporary for start-up purposes) → Boiler trip e. LALL 201 A, B Steam Drum Level Low-Low Indication (Temporary for start-up purposes) → MFT active f. LAHH 201 A, B Steam Drum Level High-High Indication (Temporary for start-up purposes) start-up) → MFT active	√	Yes	No		N/A

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Plant: Factory 6			Area : Coal-fired boiler 1			
CHECKLIST						
	a. LALL 204 A, B L Low-Low Steam Drum Level Indication (Temporary for start-up purposes) → MFT active b. LAHH 204 A, B High-High Steam Drum Level Indication (Temporary for start-up purposes) → MFT active					
5.	Conduct line check inspection. The operations team has carried out the inspection	√	Yes	No		N/A
6.	Pipe colouring is in accordance with the fluid in it and is accompanied by fluid direction indicators. Some are not equipped with direction indicators; additional ones will be added (Recommendation by Operations))	√	Yes	No		N/A
7.	Ladders, handrails and platform gratings are in good condition and safe for operational activities. a. Handrail lt.2 air distribution line to furnace side air preheater - ok b. Handrail lt.2.5 access line entrance coal feeder work. CCR direction - ok	√	Yes	No		N/A
8.	Communication equipment in the factory area (intercom/telephone) is in good condition and ready to use.	√	Yes	No		N/A
9.	All dikes are in good condition.	√	Yes	No		N/A
10.	Is the relief/PSV system available/installed? List of repairs carried out	√	Yes	No		N/A
11.	The emergency shutdown system has been rigorously tested and is confirmed to be functioning properly, providing a reliable safety measure in case of emergencies..	√	Yes	No		N/A
12.	Special PPE equipment for start-up preparation is available (ex, gas mask, SCBA, etc.). Attached is the inspection list	√	Yes	No		N/A
13.	Other unused scaffolding/temporary access has been dismantled and removed from the plant equipment area. Scaffolding in the internal furnace, wall tube, Coal Bunker, Ground Floor, and Floor 5 towards the Bag Filter has been removed	√	Yes	No		N/A
14.	All opened vessels have been inspected/repaired/cleaned by the relevant parties and are ready to be closed, along with a manhole closure report. (Outstanding: furnace area, cyclone, backpass, Primary-secondary Air preheater, Economizer, Superheater) All BAPCS Attached	√	Yes	No		N/A
15.	The hose used for system security and cleaning has been returned to its proper place..	√	Yes	No		N/A
Notes:						
	B. SECURITY SYSTEM					
1.	Gas leak detection devices (fixed gas detector & Fire Alarm System) are functioning correctly (if any). a. On the roof of the CR BB (NH3 Detector) b. The indicator light is on, but the display of the exposure results is not functioning (However, the Fixed Gas Detector does not affect the continuity of the BB1 startup process)		Yes	√ No		N/A
2.	APAR has been returned to its original position.	√	Yes	No		N/A
3.	The emergency siren is functioning correctly.	√	Yes	No		N/A
4.	All fire fighting equipment, such as fire hydrants, monitors, fire hoses, and nozzles, are available at the designated locations. The F&R K3 Team will equip some fire hose nozzles that are not in place	√	Yes	No		N/A
5.	Sprinklers are available & have they been tested? The F&R Team has carried out an inspection, and the results are promising.	√	Yes	No		N/A
6.	Repairs have been made to equipment or locations that have experienced explosive/toxic gas leaks.		Yes	No	√	N/A
7.	Emergency showers & eye washes are functioning correctly. Ground floor in front of the lift, in the demin tank area & Side 24-T-237 B Ground Floor OK	√	Yes	No		N/A
8.	Have occupational safety and Traffic Signs been installed? Signs have been relocated	√	Yes	No		N/A
Notes:						
	C. HOUSEKEEPING					
1.	All work equipment (stationary, temporary and mobile) that is not used to support the start-up process has been removed from the factory area	√	Yes	No		N/A
2.	Has the remaining demolition for repairs been cleaned?	√	Yes	No		N/A

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Plant: Factory 6		Area : Coal-fired boiler 1			
CHECKLIST					
3. Has the remaining insulation been cleaned?	√	Yes	No		N/A
4. Has the remaining food/drink packaging been cleaned?	√	Yes	No		N/A
5. Has the oil spill been cleaned?		Yes	No		N/A
6. Has the demolition scaffolding material been tidied up and does not interfere with access		Yes	No		N/A
7. Has the work area been cleaned?		Yes	No		N/A
Notes:					
D. GENERAL					
1. Emergency Procedure available	√	Yes	No		N/A
2. All work by gatekeeping TA has been carried out Attach sub-PSSR work order list checklist, equipment checklist, minutes of confined space closure	√	Yes	No		N/A
3. Is access for people in/out unobstructed?	√	Yes	No		N/A
4. Evacuation route available	√	Yes	No		N/A
5. Access for hot bolting and checking for gas leaks at start-up is available, including scaffolding		Yes	No	√	N/A
Notes:					

Table 1 shows that all aspects have been thoroughly checked to ensure the operational readiness of the coal bailer. The instrument aspect includes checking and calibrating devices such as pressure gauges, temperature gauges, and other sensors confirmed to be installed and functioning within the operating range. The electrical aspect includes checking cabling, neat panels, adequate lighting, and grounding systems that mainly function correctly, although some points have not been identified. In terms of inspection, the repaired pipelines, including the pressure vessels and steam planes that have passed inspection, are functioning correctly after being tested. The engineering aspect, which includes modifications such as adding demin water tap points and replacing expansion joints, is well documented through the Management of Change (MOC) and Replacement in Kind procedures, ensuring all changes are compliant. In the mechanical aspect, gasket and bolt installation have been carried out according to the standard, while the security of rotating parts has been reinstalled. In addition, welding and piping aspects have also been checked to ensure no leaks or structural damage. Lastly, the operational aspects ensured plant readiness with a punch list compiled, the interlock system checked, and pipe colouring was appropriately done. All critical elements of the PSSR checklist have been fulfilled, although minor improvements, such as incomplete identification of grounding points, are still needed. After the PSSR review, the start-up process was carried out according to the planned schedule.

The figure shows that the overall actual duration of start-up implementation is faster than the initial plan, from 81.5 hours to 75.9 hours, although it does not match the predetermined date. The mismatch was caused by several obstacles, namely the start of the firing process, which was planned for 12 March 2024 but could only be carried out on 13 March 2024. In addition, another problem that arose was a leak during the line-up of the BFW (Boiler Feed Water) line that the operator discovered and damage to the BFW 24-P225B pump, where the thrust bearing overheated and required a lengthy repair. As a result, start-up was held at a dry-out temperature of 500oC. Repairing the Secondary Air Fan 24-K-203A took 17.5 hours, and repairing BFW pump 24-P-225B took 94.5 hours. So, the overall start-up was delayed by 112 hours or about 4.67 days. This plan includes various vital stages such as preparation, filling the deaerator and steam drum, as well as the start-up process, which involves a gradual increase in furnace temperature, as shown in Figure 1 below:

While most critical equipment was verified in the PSSR and declared ready for start-up, some operational constraints, such as leaks during the BFW line-up and malfunctions in the PCV NG, were not identified in advance. These issues led to a temperature drop at the bottom of the cyclone, slowing down the overall start-up process. This underscores the importance of thorough checks on all aspects covered in the PSSR checklist. It's crucial that potential critical issues are anticipated and addressed in the initial checklist to ensure a smooth start-up process.

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Task Name	Duration	Start	Finish	Duration Actual	Start Actual	Finish Actual
Persiapan	**23 hrs**	**11/03/24 20:40**	**12/03/24 19:40**		**11/03/24 20:40**	
Loading Pasir 35 Ton	16 hrs	11/03/24 20:40	12/03/24 12:40	9 hrs	11/03/24 20:40	12/03/24 05:40
Tes Fluidisasi	1 hr	12/03/24 12:40	12/03/24 13:40	1,5 hrs	12/03/24 09:40	12/03/24 10:40
Pasang plug MH Furnace dan Plannum	2 hrs	12/03/24 13:40	12/03/24 15:40	2 hrs	12/03/24 10:40	12/03/24 12:40
Curring time	4 hrs	12/03/24 15:40	12/03/24 19:40	4 hrs	12/03/24 12:40	12/03/24 16:40
Fill up Deaerator dan Steam drum	**6 hrs**	**11/03/24 20:40**	**12/03/24 02:40**		**12/03/24 05:40**	**12/03/24 11:40**
Fill up deaerator	2 hrs	11/03/24 20:40	11/03/24 22:40	2 hrs	12/03/24 05:40	12/03/24 07:40
Fill up steam drum	4 hrs	11/03/24 22:40	12/03/24 02:40	4 hrs	12/03/24 07:40	12/03/24 11:40
Start Boiler Batubara-1	**52,5 hrs**	**12/03/24 19:40**	**15/03/24 00:10**		**13/03/24 10:00**	
Naikkan temp furnace ke 150°C, 30°C/Jam	4 hrs	12/03/24 19:40	12/03/24 23:40	9,75 hrs	13/03/24 10:00	13/03/24 19:45
Tahan temperatur furnace 150°C	19 hrs	12/03/24 23:40	13/03/24 18:40	19 hrs	13/03/24 19:45	14/03/24 14:45
Naikkan temp furnace dari 150°C ke 300°C	5 hrs	13/03/24 18:40	13/03/24 23:40	5 hrs	14/03/24 14:45	14/03/24 19:45
Tahan temperatur furnace 300°C	8 hrs	13/03/24 23:40	14/03/24 07:40	8 hrs	14/03/24 19:45	15/03/24 03:45
Naikkan temp furnace dari 300°C ke 500°C	6,5 hrs	14/03/24 07:40	14/03/24 14:10	6,5 hrs	15/03/24 03:45	15/03/24 10:15
Tahan temperatur furnace 500°C	6 hrs	14/03/24 14:10	14/03/24 20:10	6 hrs	15/03/24 10:15	15/03/24 16:15
Naikkan temp furnace dari 500°C ke 900°C	4 hrs	14/03/24 20:10	15/03/24 00:10	2,9 hrs	19/03/24 14:45	19/03/24 17:40

Figure 1. Plan and Realization of Coal Boiler Start Up 1

CONCLUSION

Based on the analysis of the Pre-Startup Safety Review (PSSR) implementation in the start-up process of Coal Boiler 1 at PTX, it can be concluded that PSSR has been implemented effectively in identifying and mitigating accident risks before or after the start-up process. The comprehensive PSSR procedure, which includes checklists, can cover all critical aspects, such as instruments, electrical equipment, and other things. Although there were some unidentified constraints, such as leaks during the line-up of the BFW line and malfunctions in the NG PCV, which contributed to delays in the start-up process, the overall actual duration of the start-up was still faster than the original plan. This shows that the implementation of PSSR at PTX is quite effective in maintaining process safety and minimising the risk of accidents or equipment damage. However, to improve the effectiveness of PSSR, it is necessary to conduct a more detailed inspection and stricter monitoring of all aspects of the checklist so that potential unanticipated problems can be minimised in the future.

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