Preliminary Hazard Analysis

and

Risk Assessment

for the

Wood Centre Development,

Southwood Resources - Huon
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PRELIMINARY HAZARD ANALYSIS AND RISK ASSESSMENT

Introduction

A preliminary hazard identification and risk assessment was conducted on the power station by SEMF to satisfy the requirements of Section 3.7.6 of the DPEMP guidelines. This condition requires a Preliminary Hazard Analysis to be undertaken on the power station. This study was done in accordance with AS/NZS 4360, 1999 Risk Management Standards.

The potential hazards were systematically identified using a preliminary HAZOP study (Appendix A — HAZOPS Template), (Perry R.H, 1998) in conjunction with the schematic process flow diagram for the power station (Appendix B — Power Station Schematic). These identified hazards are detailed under each specific operational area, together with relevant actions and recommendations on solutions for prevention.

To determine whether a quantitative risk assessment is required, the Rapid Environmental Checklist (RERAC), (Jones M.K. 1995) has been selected and adapted in conjunction with Hazard Frequency Tables (Klietz T.A. 1992) as a suitable procedure for providing a preliminary quantitative assessment of the likelihood and severity of a hazardous incident occurring. With this preliminary assessment, accurate judgements can be made on the necessity of a quantitative risk assessment.

Methodology

The HAZOP study allows systematic identification of potential hazards associated with risks to people, process plants, and the environment. In this study, it has been used to identify hazardous effects caused by deviations in normal process operations.

The RERAC Process is primarily used to quantitatively assess hazard scenarios and its associated risks to the environment. In this study, its principal function was to assess the major hazards identified in the previous HAZOP study. A more detailed explanation of the RERAC method can be found in the following Risk Assessment section.

Hazard Identification

The following section makes use of Appendix A to identify hazards associated with the relevant area/process unit. Recommendations on mitigation measures are also detailed.

**Fuel Stockpile**

Hazard ID: Fire Hazard

Large amounts of fuel wood are stored for fuel supply to the boiler. The fuel stockpile presents an ideal situation for the propagation of a fire.
The appropriate fire hydrants are to be available, to enable containment and reduce the risks of further propagation.

**Boiler**

The boiler's primary function is to generate heat by complete combustion of fuel wood with air. This heat is utilised to generate steam from water. The following hazards were identified as having the most significant impact. Other possible deviations, which do not constitute any foreseeable hazards are not mentioned below.

**Hazard ID: No Water Flow**

Failure of the feed water pump to the boiler will result in no water flow into the boiler, therefore no heat sink for the combustion process. This will lead to a release of abnormally hot flue gases. This may cause thermal damage to equipment down stream, and ultimately result in release of very hot gases at the stack.

**Action/Recommendation:**

Proper control alarms in place will warn of any deviation in temperature, or water flow, and alert operators on cause of malfunction and allow them to shut down the process before the deviation causes damage.

**Hazard ID: Feed Flow Rate Deviation**

A deviation in the levels of fuel wood and combustion air will have an effect on the combustion products generated. A defined fuel:air ratio must be complied with, to optimise the combustion process. The effects of deviations such as more fuel wood and/or less air are: incomplete combustion, and a release of larger amounts of particulate matter, undesirable gaseous compounds, including VOCs, noxious gases, and other combustion by-products. These gases are potentially harmful in significant concentrations, and contribute to the greenhouse gas problem.

**Action/Recommendation:**

Control systems are to be put in place to monitor and regulate the flow rates of the fuel wood and air, as well as the temperature within the boiler furnace. Any deviation will warn the operators, and immediate corrective action is required. All effluent gas streams are to comply with set DPIWE guidelines for air emissions.

**Hazard ID: Presence of Contaminants in Feed**

Contaminants present with the fuel wood, such as off specification fuel wood material, or the boiler water. The latter may occur due to abnormal water treatment or domestic water supply composition. The former will result in abnormal compositions in flue gases, and perhaps will have some effect on the generated heats of combustion. The latter will produce a blowdown stream with an abnormal chemical composition bound for the sewage treatment plant. Provided that the sewage treatment plant is
robust enough to handle such deviations, then this incident will pose no further problems.

Action/Recommendation:

The level of hazard and course of action relating to the abnormal flue gas composition will depend on the types and concentrations of chemicals present. Control systems and continuous monitoring of the quality of the fuel wood going into the boilers will prevent this.

**Steam Lines**

Carries live high-pressure steam from the boiler to the turbine.

**Hazard ID: High Pressure Steam Build-up**

The event of high-pressure steam build-up, due to blocked lines or throttled valves, may lead to line rupture and pressure loss at the weaker joints. Consequently, this pressure loss will result in decreased turbine efficiency, and venting material may cause electrical and structural damage and pose a hazard to nearby workers.

**Action/Recommendation:**

Regularly scheduled maintenance on all piping infrastructures, repair any leaks as soon as possible, and regular structural testing.

**Turbine**

Converts the heat energy harnessed from the high pressure steam, to work, and generates electricity.

**Hazard ID: Inadequate Turbine Maintenance**

Inadequate maintenance such as failure to properly service the machine, or incorrect installation, will result in physical contact between moving metallic parts within the turbine. This will lead to increased wear, and eventually cause severe internal mechanical damage. There is no foreseeable effect of turbine malfunction on the environment or human life.

**Actions/Recommendation:**

A proper and rigorous maintenance procedure should be implemented and complied with, to prevent this event from occurring.

**Cooling tower**

Cools and recycles the cooling water used to condense the low-pressure steam from the turbine.
Hazard ID: Cooling Tower Non-functional

Reduced cooling water flow due to cooling water pump malfunction will result in a less effective condenser, therefore a less efficient turbine, due to the back pressure exerted by uncondensed steam. The reduced amount of steam being condensed will eventually result in a build-up of steam upstream of the condenser, leading to line ruptures. Line ruptures are potentially hazardous to nearby workers, mechanical, and electrical equipment. This hazard has no foreseeable effects on the environment.

Actions/Recommendation:

Instrumentation measures such as: flow meters installed in the cooling water lines will detect reduced flow; a pressure transmitter in the line upstream of the condenser will indicate any deviation from the set point pressure, and alert operators of the deviation. In the event that the line pressure does increase significantly, pressure relief valves will be present to vent out the extra pressure, and reduce the likelihood of human injury.

**Particulate filter system**

Filter out particles produced during combustion in two stages: a coarse filtration, followed by a fine filtration stage.

Hazard ID: Blocked Filters

Backlog of hot flue gases, due to the blocked lines, will cause an increased resistance at the induced draft fan, resulting in limited out flow of gas. The rate of combustion in the boiler will be affected, and incomplete combustion will occur, due to the lack of oxygen feed. This will result in more coarse size particulates being generated, as well as CO, NOx, and other combustion by-products. The effluent gases produced will be released into the atmosphere, and are potentially hazardous to human life and the surrounding environment.

Actions/Recommendations:

Control systems in place will impose a decrease in the conveyor speed, therefore less fuel wood in, to accommodate the reduced oxygen entering. Temperature, oxygen, and CO alarms will alert the operators of the deviation, and will require their immediate attention, because if left unattended, will lead to complete shutdown. Compliance to a regular maintenance schedule will prevent this from occurring.

Hazard ID: Non-functional Electrostatic Precipitator (ESP)

Fine dust particles will not be removed from the flue gas stream, therefore the fines will go out through the stack.

Actions/Recommendation:

An air emission monitor, which measures the level of particulates present in the flue gas, is located in the stack. Above a certain particulate level, an alarm will alert
operators of the deviation, in which the operators will be required to alter the feed and boiler conditions to reduce the amount of particles generated in the combustion process, or to carry out corrective action to remedy this problem.

**Air Circulation System**

The air circulation system comprises of two fans, the induced draft fan, and the combustion air fan. The induced draft fan draws combustion air generated in the boiler, and discharges it out through the stack. The combustion air fan pushes air into the boiler, and provides the air required for combustion. These two fans function to generate a more efficient air flow both into and out of the boiler.

**Hazard ID: Non-functional Air Circulation System**

Failure of one or both of the fans will lead to reduced air flow through the system. The rate of combustion in the boiler will be affected, and incomplete combustion will occur, due to the lack of oxygen feed. This will result in more coarse size particulates being generated, as well as CO, NOx, and other combustion by-products. The effluent gases produced will be released into the atmosphere, and are potentially hazardous to human life and the surrounding environment.

**Actions/Recommendations:**

Control systems in place will impose a decrease in the conveyor speed, therefore less fuel wood in, to accommodate the reduced air flow. Temperature, oxygen, and CO alarms will alert the operators of the deviation, and will require their immediate attention, because if left unattended, will lead to complete shutdown. Compliance to a regular maintenance schedule will prevent this from occurring.

**Chemical Storage Area**

The chemical storage area stores chemicals used for water treatment.

**Hazard ID: Fork Lift Accidents**

Fork lift operator while transferring storage containers, pierces one of the containment units, pumps, or lines, resulting in loss of containment of the chemicals. The hazard depends on the nature of the chemicals spilled.

**Action/Recommendation:**

Protective bunding should be present on all sensitive equipment in the storage area, and the appropriate chemical spill kits should be readily available if the incident does occur.

**Hazard ID: Chemical Accidents**

The hazardous nature of the chemicals impose a risk in themselves, in case of spillage, misuse, or a fire.
Entry into the storage area should be limited to trained personnel, wearing the appropriate personal protective equipment (PPE). Appropriate chemical spill kits should be readily available in case of accidents. Safety shower, eye-wash, and first aid facilities should be available in case of emergency. Material and Safety Data Sheets (MSDS) should be available for emergency personnel in an accident situation.

**Risk Assessment**

The preceding Hazard Identification section is used for this Risk Assessment section to focus on the most critical hazards present within the power plant site.

The Rapid Environmental Risk Assessment Checklist (RERAC) methodology has been used to quantify the likelihood and severity of an incident or hazard. These result in a ranking of each hazard in terms of total assessed risk (TAS). Events that are ranked the greatest TAS should be given the highest priority in terms of preventative action (Appendix C — RERAC Ranking Scales).

$$\text{Total Assessed Risk (TAS)} = \text{Likelihood} \times \text{Severity}$$

The acceptability of the hazards can then be decided for the particular activity depending on which of the three following categories they fall in.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>DESCRIPTION</th>
<th>TAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category One</td>
<td>Immediate action required to reduce TAS to 9 or below.</td>
<td>&gt;14</td>
</tr>
<tr>
<td>Category Two</td>
<td>Medium term action required to reduce TAS to 9 or below.</td>
<td>9-14</td>
</tr>
<tr>
<td>Category Three</td>
<td>Action depends on company policy and resources.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Long term target should be for all TAS scores to be &lt;5.</td>
<td>&lt;9</td>
</tr>
</tbody>
</table>

**Principal Site Hazards**

As mentioned above, the HAZOPS report has assisted in identifying the following areas as having the potential to kill, injure, or cause significant engineering and environmental damage, resulting from abnormal operating conditions or accident based activities:

- Fuel stockpile
- Boiler
- Steam Lines
- Turbine
- Cooling Tower
- Particulate Filter System
- Air Circulation System
Each of these identified areas have been assessed under the RERAC method.

The following table details the Hazard Category Summary for the areas identified above. Hazard activities previously identified in the Hazard Identification section, which has a TAS ranking of <4 have not been included in this table because these hazards are deemed to be of significant consequence.

Table 2  
**Hazard Category Summary for selected critical areas within the Southwood Power Plant**

### Category One Hazards (TAS>14)

<table>
<thead>
<tr>
<th>Activity</th>
<th>L</th>
<th>S</th>
<th>TAS</th>
<th>Consequence</th>
<th>Preventative Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NIL</td>
<td>NIL</td>
</tr>
</tbody>
</table>

### Category Two Hazards (9<TAS<14)

<table>
<thead>
<tr>
<th>Activity</th>
<th>L</th>
<th>S</th>
<th>TAS</th>
<th>Consequence</th>
<th>Preventative Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>NIL</td>
<td>NIL</td>
</tr>
</tbody>
</table>

### Category Three Hazards (4<TAS<8)

<table>
<thead>
<tr>
<th>Activity</th>
<th>L</th>
<th>S</th>
<th>TAS</th>
<th>Consequence</th>
<th>Preventative Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>High pressure steam build-up</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>Line rupture, venting material may cause electrical and structural damage, and injure nearby workers.</td>
<td>Regularly scheduled maintenance on all piping infrastructure, and structural testing.</td>
</tr>
<tr>
<td>Fuel feed flow rate deviation</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Incomplete combustion resulting in the generation of undesirable gaseous compounds such as CO, and increased levels of particulate matter.</td>
<td>Continuous monitoring of feed flow rates, as well as CO levels leaving through the stack.</td>
</tr>
<tr>
<td>Non-functional air circulation system</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Incomplete combustion will occur, resulting in coarse size particulates generated, as well as CO, NO\textsubscript{x}, and other combustion by-products.</td>
<td>Temperature, oxygen, and CO alarms will alert the operators of the deviation. Compliance to a regular maintenance schedule will prevent this from occurring.</td>
</tr>
<tr>
<td>Non-functional</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Build-up of low</td>
<td>Recommendations</td>
</tr>
</tbody>
</table>
### RERAC Summary

Hazard actions and recommendations have been defined in the Hazard Identification and RERAC sections of this report to reduce the frequency, and in most instances, the severity of a hazard event. As detailed in Table 2, there were no Category One or Category Two hazards identified. The vast majority of all RERAC assessments fell under a TAS ranking of 5, the recommended level for industry operations.

Category Three hazards are deemed minor, and company policy should dictate that a long term goal be set to reduce the TAS scores to below 5. The most significant of
these Category Three hazard is the hazard associated with the rupture of lines containing high pressure steam. Line ruptures pose a direct hazard to operators and electrical equipment. Implementation of the recommended control measures will significantly reduce the likelihood and severity of this event. There are no direct environmental effects associated with this hazard.

This preliminary RERAC study has not identified any catastrophic environmental hazard event scenarios.

**Conclusion**

Based upon the HAZOP and RERAC studies, it is concluded that if the actions and recommendations outlined in this report are acted upon, then there is little risk associated with hazards that have significant environmental consequences.
## Appendix A — HAZOPS Template Guide Diagram

<table>
<thead>
<tr>
<th>Guideword</th>
<th>Meaning</th>
<th>Example of Deviation</th>
<th>ID Hazard</th>
<th>Comment</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No (Not or None)</td>
<td>The activity is not carried out or ceases.</td>
<td>No flow in pipe, no reactant charged to process, batch not cooled, check omitted.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Of</td>
<td>A quantitative increase in an activity.</td>
<td>More (higher, longer) quantity flow, temp, pressure, batch, concentration, time.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less Of</td>
<td>A quantitative decrease in an activity.</td>
<td>Less (lower, shorter) of above.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More Than or As Well As</td>
<td>A further activity occurs in addition to the original activity.</td>
<td>Impurities present, extra phase (solid or gas in liquid phase), extra (unplanned) process operation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part Of</td>
<td>The incomplete performance of an activity.</td>
<td>Reduced strength, missing component, operation only part-completed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reverse</td>
<td>Inversion of an activity.</td>
<td>Back flow or back pressure, heat rather than cool.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sooner/Later Than</td>
<td>An activity occurring at the wrong time relative to other activities.</td>
<td>The activity occurs at the wrong time.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (Than)</td>
<td>Complete substitution of an activity, no part of the intention is achieved.</td>
<td>Wrong material charged, non-routine conditions, start up, shut down, maintenance, cleaning, etc. failure of services.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B — Power Station Process Flow Schematic

(Insert diagram here)
Appendix C — RERAC Ranking Scales

In the RERAC method, the following ranking scales are used:

**Likelihood Score**  
*(Frequency of Possible Cause)*

<table>
<thead>
<tr>
<th>Event Probability</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent Event (25 times per year)</td>
<td>5</td>
</tr>
<tr>
<td>Probable Event (5 times per year)</td>
<td>4</td>
</tr>
<tr>
<td>Occasional Event (1 time per year)</td>
<td>3</td>
</tr>
<tr>
<td>Remote Possibility (1 time per 5 years)</td>
<td>2</td>
</tr>
<tr>
<td>Improbable Event (1 time per 25 years)</td>
<td>1</td>
</tr>
</tbody>
</table>

**Severity Score**  
*Real Hazard Index*

<table>
<thead>
<tr>
<th>Severity</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>Major long-term engineering &amp; environmental impacts and/or damage usually resulting in fatalities, multiple injury victims and/or highly visible to the public.</td>
<td>5</td>
</tr>
<tr>
<td>Major</td>
<td>Major short-term engineering &amp; environmental impacts and/or significant human injury or injuries potentially fatal.</td>
<td>4</td>
</tr>
<tr>
<td>Significant</td>
<td>Minor short-term engineering &amp; environmental impact and/or short-term human injuries and/or low public visibility.</td>
<td>3</td>
</tr>
<tr>
<td>Marginal</td>
<td>Marginal short-term engineering &amp; environmental damage and/or minor human injuries.</td>
<td>2</td>
</tr>
<tr>
<td>Negligible</td>
<td>No measurable effect on the engineering or environmental condition on site, no effect on workforce, not visible to the public.</td>
<td>1</td>
</tr>
</tbody>
</table>