Test Plan

Section 1- Introduction:

This document outlines the plan to test and verify compliance to engineering specifications for Dresser Rand’s Olean Plant VECTRA power turbine assembly room expansion. The Engineering specifications were established in September 2009 and were the basis for design and construction. These specifications will be used to verify and validate the feasibility of all work completed. Engineering specifications can be found in Appendix A of this document.

Section 2- Recordable/ Near Miss Incidents:

Due to the similarity of these two specifications, one test plan will be sufficient to test both recordable and near miss injuries. VECTRA safety form (Appendix B) should be filled up by the VECTRA area manager on a quarterly basis. This form would allow management to verify that safety standards established as part of the expansion process meet or exceed the requirements mentioned in engineering specs.

A recordable injury is an injury that would result in medical treatment beyond first aid, days away from work, restricted work, and loss of consciousness or death (OSHA.com). A near miss is where a recordable injury could have occurred but did not. By preventing near misses, recordable injuries will not occur in the future. This would ensure a safer work environment and potential expenses in workers compensation claims. Presently there are no recordable injuries or near miss incidents in the VECTRA room. One of the goals of the project is to maintain this. The metric for measuring this spec in injuries per quarter in the VECTRA room and the ideal value of this metric would be 0.

Section 3- VECTRA Production Time and Unit Setup Time Delay:

Due to the similarity of these two specifications, one test plan will be sufficient to test both production time and unit setup time delay. The production cycle of 30G and 40G VECTRA power turbines is ≤4 weeks per unit. The entire cycle can occur within the time frame of 4 weeks if there are no setup delays, parts missing, defective part repairs, supplier delays, testing delays or other related delays. The ideal value for the metric is 3 weeks per unit. It is critical that the production time is minimal since DR has meet project competition and delivery dates for each of their customers.
The current process of building a VECTRA turbine includes more than 5 days of unit setup delay time. The ideal value of delays due to the above mentioned reasons need to be no more than 2 days per cycle. The form in Appendix C would help analyze if design changes in the VECTRA room expansion helped in reducing the delay and meet the engineering specification.

The form in Appendix C would help the area manager to analyze why there were production delays and help avoid them for future build cycles. The final portion of the form asks the area manager to list down the possible causes for delay. The following things are some of the indicators of delay in production time - Part unavailability, missing tools/equipment., poor material flow and operator efficiency.

**Section 4- Economic Payback:**

Many of our decisions were influenced by capital. Every proposal that we present to D-R must be able to pay itself off in a reasonable amount of time. Most of these proposals will quickly pay themselves off with an increased production rate. Examples of such include new cranes, build stands, tooling, work surfaces, and expanded clean room space. These paybacks will not be analyzed because they will require data acquisition and analysis after the project is complete, which there is insufficient time for. However, the removal and replacement of the oven is one economic analysis that we could speculate. There will not be a true test of this payback. To get a true payback, energy consumption of the existing oven and new oven would have to be analyzed. Just as before, there is insufficient time to accomplish this. However, assumptions and speculations can be used to examine the payback before the oven is installed. Using benchmarking to compare the old oven to a newer one of similar technology, the energy consumption is approximated. The new oven has published energy consumption data. Putting these together can give an economic payback, as shown on the EDGE project website.

**Section 5- Non-Ergonomic Movement:**

There were a few non-ergonomic movements that were identified during the VECTRA room analysis. All of them occur at different phases of the VECTRA build process. Since it is not possible to observe all the ergonomic movements throughout the build cycle of one unit, it is difficult to measure the number of non-ergonomic movements/day. A checklist of these movements that an operator can use to record the type of non-ergonomic movements he had to perform that day, may give us an idea of how much period of time or how many times these occurred. This can be carried out for a week before the design changes occur and a week after the construction and inclusion of the solutions suggested for non-ergonomic movements are incorporated in the room. This will help the team verify if the changes to the design of the room and the proposed ergonomic solutions did in fact help improve the work conditions of the operators. The marginal value of non ergonomic movements per day is currently unknown, but the ideal value in this situation needs to be close to zero.
Section 6- Usable Work Surface:

The current total work surface is 40\text{ft}^2 and there is a requirement for 25% additional surface for the operators and engineers to work in the VECTRA room. The second build stand requires double the capacity of work surface; hence the new design needs to consider a 250% increase in usable work surface area. The Ideal value for this metric would be 100 \text{ft}^2. The detail design for the expansion of the VECTRA room includes a counter top (31 \text{ft}^2), Work Surface with under-Cart Storage (21 \text{ft}^2) and Work Surface at the back wall (43 \text{ft}^2). New Total Work Surface Area according to the detail design of the expanded VECTRA assembly room is 95 \text{ft}^2. This is close to the Ideal value of the engineering spec. There may be requirement in the future for more work surface area due to unforeseen reasons. The followings question can be asked after the construction to validate that the increased work surface would suffice the need, for use of both the build stands simultaneously.

i. Is the current work surface sufficient, too much or just enough?

ii. What objects occupy most amount of space on each of the work surfaces?

iii. Can any of those objects be kept in another location like in storage rack or wall mounted?

iv. How much more space would be required and for what purpose?

v. Are the heights and widths of the work surfaces ideal? Would any changes make the operator’s and engineer’s job easier?
### Appendices

**Appendix A: Engineering Specification**

<table>
<thead>
<tr>
<th>Metric No.</th>
<th>Metric</th>
<th>Importance</th>
<th>Units</th>
<th>Marginal Value</th>
<th>Ideal Value</th>
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<td>Recordable Injuries</td>
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<td>Injuries/ Month</td>
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<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Near Miss Incidents</td>
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<td>Near Misses/ Month</td>
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<td>VECTRA Production Time</td>
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<td>Weeks/ Unit</td>
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<tr>
<td>4</td>
<td>Economic Payback</td>
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<td>Years</td>
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<td>\leq 3</td>
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<tr>
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<td>Days</td>
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<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Non-Frictional Movements</td>
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<td>Movements/ Day</td>
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<td>Usable Work Surface</td>
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<td>\text{ft}^2</td>
<td>&gt;80</td>
<td>&gt;100</td>
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</tbody>
</table>
Appendix B

VECTRA Safety Form for Assembly Workers

Completion of this document will be required to occur at the end of each month and turned into manager. This is an anonymous survey. Please put an “X” next to your selection. Please comment when appropriate.

During the last month, did you get injured at work in a way that prevented you from going to work?

Yes: ___  No: ___  Comment: ________________________________

During the last month, did you get injured at work in a way that still allowed you to work?

Yes: ___  No: ___  Comment: ________________________________

During the last month, did you feel you were put in a position where you could have gotten injured?

Yes: ___  No: ___  Comment: ________________________________

Can you think of any improvements to the manufacturing process or tooling that would decrease the risk of injury in the VECTRA area?

Yes: ___  No: ___  Comment: ________________________________
___________________________________________________________________________________
___________________________________________________________________________________
VECTRA Safety Form for Managers

Completion of this document will be required to occur at the end of each month and turned into manager. This is an anonymous survey. Please put an “X” or quantity next to your selection. Please comment when appropriate.

During the last month, were there any recordable injuries in the VECTRA Area that prevented a worker to come to work?

How Many? _____   Comment: __________________________________________

During the last month, were there any recordable injuries in the VECTRA Area that still allowed the employee to work?

How Many? _____   Comment: __________________________________________

During the last month, were there any near-miss injuries in the VECTRA Area?

How Many? _____   Comment: __________________________________________

During the last month, did an assembly worker approach you with a safety concern regarding the VECTRA Area?

Yes: ___   No: ___   Comment: __________________________________________

If yes, how was it handled? __________________________________________

Can you think of any improvements to the manufacturing process or tooling that would decrease the risk of injury in the VECTRA area?

Yes: ___   No: ___   Comment: __________________________________________

____________________________________________________________________________

How does the safety record of the VECTRA Area compare to the rest of the plant?

VECTRA Injuries: _____   Plant Injuries:_______
Appendix C

Effect of VECTRA Expansion on Production Efficiency

Completion of this document will be required to occur at the end of each month and turned into manager. This is an anonymous survey. Please put an “X” or quantity next to your selection. Please comment when appropriate.

What was the average production time for a new unit before the VECTRA production area was expanded? _____ Days

What was the average production time for a new unit after the VECTRA production area was expanded? _____ Days

How do these numbers compare? Better: ____  Worse: _____

What is the reason for the difference? Comment: ____________________________________________

____________________________________________________________________________________

Were there any common problems during the manufacturing process that could be addressed to reduce production time or increase production rate? If yes, how will this be addressed?

Yes: ___  No: ___  Comment: ____________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________