

| Checklist  | Remarks         | Action (X)       |  |
|--|-----------------|------------------|--|
| <p style="text-align: center;"><b>Project System Audit<br/>Mechanical Equipment Group</b></p> <p><b>Note:</b> Not all items of the checklist shall be checked. It depends on the status of the work and whether it is the first, second or third audit.</p> <p>⊗ = EH&amp;S related question</p> <p><b>1. Project Definition</b></p> <p><b>1.1</b> Is the Project Procedure and Execution Manual (PPEM) available?<br/><br/>What is the status, issue and date?</p> <p><b>1.2</b> Does the PPEM properly describe the scope of work and services expected from your discipline to execute the work?</p> <p><b>1.3</b> Have the applicable governmental / local authority design codes / norms / rules / standards / guides been listed in the PPEM?<br/><br/>Are they available in the discipline group?</p> <p><b>1.4</b> Have Company / client standards / norms / guides / practices / procedures / forms and specifications, applicable and to be used by your discipline, been listed in the PPEM?<br/><br/>Are they available in your group?</p> <p><b>1.5</b> Are specific project (account) specifications and / or amendments applicable and to be used?<br/><br/>Have these been certified, including client's comments incorporated?<br/><br/>Have they been listed in the PPEM?</p> <p><b>1.6</b> Does the PPEM contain an instruction how to handle project variations of the original scope of work, including project development changes, regarding administration, approvals and distribution prior to be implemented?</p> <p><b>1.7</b> Has the spare part philosophy been spelled-out in the PPEM or in a separate document?</p> <p><b>1.8</b> Has a preferred or approved supplier's list been included in the PPEM for the equipment / component / packages to be handled by your</p> |                 |                  |  |
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|--|-----------------|------------------|--|
| <p>group?</p> <p><b>1.9</b> To what extent have safety in design features been addressed in the PPEM?</p> <p><b>2. Engineering Technical</b></p> <p><b>2.1</b> Have long lead items been clearly defined?</p> <p><b>2.2</b> How is it ensured that equipment / component/ package specifications are:</p> <ul style="list-style-type: none"> <li>• performed in sequence of criticality?</li> <li>• coordinated with other disciplines concerned, where required?</li> <li>• meeting the quality criteria set in the applicable design codes and governmental and / or local statutory requirements?</li> </ul> <p><b>2.3</b> What arrangements have been made with VPC to ensure proper distribution of supplier prints for package units and supplier designed equipment?</p> <p><b>2.4</b> How has the filing system for the discipline been organized?</p> <p><b>2.5</b> Are checkprints and masterprints of documents available?</p> <p><b>2.6</b> Are previous issues of documents kept with the discipline?</p> <p>Are they properly marked "void" or "redundant"?</p> <p><b>2.7</b> How is it ensured that:</p> <ul style="list-style-type: none"> <li>• input for electrical drivers and other electrical components are properly coordinated with the lead electrical and noise engineer, incl. supplier document checking / approval?</li> <li>• input for control system items and components are properly coordinated with the lead control system engineer?,</li> <li>• instrument nozzle connections, orientations and accessibility on drawings of supplier designed equipment are reviewed, commented and / or approved by the lead instrument</li> </ul> |                 |                  |  |
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|---|-----------------|------------------|--|
| <p>engineer?</p> <ul style="list-style-type: none"> <li>• in case interconnecting piping is involved i.e. on package units, proper coordination takes place with the lead piping engineer?</li> <li>• the structural steel lead engineer is involved in case of package units, when the supplier provides all supporting structural steel?</li> <li>• the static equipment engineer will take care of pressure vessel components, steam drums, pulsation bottles of recip. compressors etc?</li> <li>• process medium information is complete, i.e. info on toxicity, flammability, cleanliness.</li> </ul> <p><b>2.8</b> Has a conservation period after shipping been specified?</p> <p><b>2.9</b> Have painting requirements for stainless steel pressure parts been specified?</p> <p><b>2.10</b> What has been specified concerning the relationship between stainless steel and galvanized / zinc paint?</p> <p><b>2.11</b> Computer calculations:</p> <ul style="list-style-type: none"> <li>• are client's software programs to be used?</li> <li>• if so, have they been listed in the PPEM with issue number, date and status?</li> <li>• if not, have our programs been certified for use by the discipline manager?</li> <li>• have our programs been approved by the client?</li> <li>• if a design code is involved how is it verified that the latest design code issue has been implemented in the program?</li> </ul> <p><b>2.12</b> Is it expected that our standard computer programs need to be updated to comply with the requirements of this project?</p> <p><b>2.13</b> Is it anticipated that non-routine calculations are required?</p> |                 |                  |  |
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|---|-----------------|------------------|--|
| <p><b>2.14</b>    <input checked="" type="checkbox"/> Has a maximum level for noise generating equipment been defined and agreed upon by the noise engineer and/or the client?</p> <p>Has the noise engineer been consulted to fill out the noise data sheets for equipment prior to "for bid" issue of requisitions where applicable?</p> <p>Has he commented on and approved the supplier noise data sheets for noise generating equipment and components, incl. ejectors / eductors?</p> <p><b>2.15</b>    <input checked="" type="checkbox"/> Have nozzle forces been discussed with the piping engineer and communicated with suppliers?</p> <p><b>2.16</b>    Have required material certificates been clearly identified for each piece of equipment within the scope of the mechanical equipment group?</p> <p><b>2.17</b>    <input checked="" type="checkbox"/> Are the insulation and painting requirements for equipment and components available?</p> <p>To what extent have Painting / Insulating (P/I) quantification sheets been explained to selected suppliers during bid - explanation / pre-award meetings?</p> <p>To what extent have supplier completed quantification sheets for non-static equipment been checked by the discipline prior to submittal to the P/I group?</p> <p><b>2.18</b>    Has insulation and / or refractory information been received from suppliers according to schedule?</p> <p><b>2.19</b>    How is process data transferred to the mechanical equipment group?</p> <p>Have the process data sheets been reviewed by the mechanical group prior to design?</p> <p><b>2.20</b>    <input checked="" type="checkbox"/> Has a material selection scheme (MSS or Matflow) been prepared by the Process Dept.?</p> <p>Have the materials been checked by the mechanical group to be in accordance with the MSS?</p> |                 |                  |  |
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|--|-----------------|------------------|--|
| <p><b>2.21</b> Is a licensor involved in the project?</p> <p>If yes, have requirements been listed stating which equipment needs their review?</p> <p>To what extent have these requirements been met?</p> <p>Have we introduced deviations from licensor requirements without obtaining their formal approval?</p> <p><b>2.22</b> Have the authority requirements been established and coordinated with the authority engineer?</p> <ul style="list-style-type: none"> <li>• which authorities are involved?</li> <li>• which documents have to be submitted for approval and by whom?</li> <li>• is sufficient time allowed for presentation and approval time?</li> </ul> <p><b>2.23</b> Is the itemized list of all equipment requiring process engineering review of the bids and supplier documents available?</p> <p><b>2.24</b> Are the special job requirements discussed with the process supervisor?</p> <p>Are any records available to substantiate such requirements?</p> <p><b>2.25</b> Is foundation loading information of supplier designed equipment issued regularly to civil / structural department?</p> <p>Have foundation loading tables been issued and regularly updated?</p> <p><b>2.26</b> ☒ Have HVAC requirements been defined where required?</p> <p><b>2.27</b> Is there a list available that specifies the need for service of outside consultants for special items?</p> <p><b>2.28</b> How is ensured that correct revisions of EFD's/ UFD's are used as part of requisitions / specifications?</p> <p><b>2.29</b> ☒ Has the control philosophy on supplier EFD's for package units been agreed?</p> <p><b>2.30</b> If process is responsible for preparation of</p> |                 |                  |  |
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| <p>start-up procedures and / or operating manuals, how is it ensured that logics by suppliers are prepared following exactly the same philosophy? (for package units only)</p> <p>How are the design conditions such as minimum design temperature, etc., transferred to the mechanical group?</p> <p><b>2.31</b> Have other disciplines been involved in any formal reviews of the supplier package unit EFD's?</p> <p><b>2.32</b> Are there any indications that either in the group or within Company / client / manufacturers etc., there are unfavorable conditions which could make Company liable and add cost to the project?</p> <p><b>3. Engineering General</b></p> <p><b>3.1</b> Are job related internal instructions used to execute the scope of work and services?</p> <p>Have all group members and other possible disciplines been provided with a copy?</p> <p><b>3.2</b> In case client's standards / details /procedures/ forms etc., must be used are they technically acceptable for the type of project under consideration?</p> <p>Has a formal approval from the client been obtained to deviate from their job requirements?</p> <p><b>3.3</b> Have equipment test and witnessing criteria for package units and rotating equipment been defined?</p> <p><b>3.4</b> How is the status of checks of supplier drawings against Company engineering documents and their (re) issues documented?</p> <p><i>Engineering Flow Diagrams etc.</i></p> <p><b>3.5</b> ☒ Are the start-up and shut-down requirements available?</p> <p>In what form?</p> <p><b>3.6</b> ☒ Are the maintenance requirements, drainage and blowdown philosophies for supplier package units available?</p> <p>In what form?</p> |                 |                  |  |
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| <p>Have these been coordinated with the lead process engineer and properly minuted?</p> <p><b>3.7</b>    ⊗ Is a pressure / temperature profile available?</p> <p><b>3.8</b>    Is a planning list available of all deliverables to be prepared by the mechanical equipment group?</p> <p><b>3.9</b>    Are copies of all EFD's provided to the mechanical equipment group for information?</p> <p><b>3.10</b>   Are supplier EFD's for e.g. package units available?</p> <p><b>3.11</b>   What is the issue status of the Company engineering flow diagrams?</p> <p><b>3.12</b>   How is the mechanical equipment group informed about pending EFD changes after "certified for detail design" issue?</p> <p><b>3.13</b>   What is the frequency of EFD issues?<br/>When was the last (re)issue?</p> <p><b>3.14</b>   Are the C1 and C2 Piping Specifications available.</p> <p><b>3.15</b>   ⊗ Have tracing requirements on vessel data sheets been indicated by process?</p> <p><u>Equipment Lists</u></p> <p><b>3.16</b>   What is the frequency of receipt of new issues of the equipment list?<br/>When was the last issue received?</p> <p><b>3.17</b>   Have package units been properly identified in the equipment list including a listing of the (numbered) components?</p> <p><b>3.18</b>   What is the qualification of the kWatts as listed?<br/><br/>based on estimated efficiencies<br/><br/>based on supplier supplied data<br/><br/>"installed" kWatts</p> <p><b>3.19</b>   ⊗ Has the authority classification list been</p> |                 |                  |  |
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| <p>issued?</p> <p>Has subject document been commented/ reviewed on a regular basis by the mechanical engineer?</p> <p><u>Coordination before Purchase</u></p> <p><b>3.20</b> Has the noise engineer been consulted in the review of bids as required?</p> <p><b>3.21</b> What action has been taken to ensure that in pre-award and / or bid explanation meetings, the process engineer is invited as well as a representative of the inspection Department plus any other discipline engineers as required?</p> <p><b>3.22</b> ☒ To what extent have safety and quality aspects been addressed in these meetings?</p> <p><b>3.23</b> Has the installation philosophy been agreed with the client?</p> <p>Has this philosophy been covered in the documents, i.e. specifications / standards and typical details / hook-ups to be followed in supplier detailed design package units?</p> <p><b>3.24</b> ☒ Has the accessibility of supplier designed package units been coordinated with other disciplines concerned?</p> <p>How has this been documented?</p> <p><b>3.25</b> Have miscellaneous materials for heat tracing / installation / mounting etc. been defined?</p> <p>Have supply sources been dictated for supplier detailed designed package units or has this been left to the suppliers to decide?</p> <p><b>4. Job Control</b></p> <p><b>4.1</b> Where has the budget for the mechanical equipment group been defined?</p> <p><b>4.2</b> Was the lead mechanical equipment engineer involved in or did he accept the manhour estimate, planning and manpower curve for executing the scope of work and services required for the project?</p> <p><b>4.3</b> Has the Project Execution Control System (PEC) been prepared for the scope of work and services required and used for progress</p> |                 |                  |  |
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| <p>measurement?</p> <p><b>4.4</b> How much is the progress measured against the PEC summary for the mechanical equipment group? State date.</p> <p><b>4.5</b> What is the efficiency reported in PEC?</p> <p><b>4.6</b> How does the final expected manhours requirement relate to the assigned manhour budget?</p> <p><b>4.7</b> Have changes in the scope of work been processed in time?</p> <p><b>4.8</b> Have the PEC and scheduled manhours been adjusted based on the approved project variations?</p> <p><b>4.9</b> Does the lead mechanical equipment engineer receive a copy of the weekly LDS / HOTA print-out?</p> <p><b>4.10</b> What percentage of mechanical data sheets, requisitions / specifications have been completed?</p> <p><b>4.11</b> Have all PDS's been released for mechanical design?</p> <p>If not, assess percentage complete</p> <p><b>4.12</b> What percentage PDS's have been changed after release for mechanical design?</p> <p><b>4.13</b> Which checklists have been used to perform technical bid evaluations?</p> <p><b>4.14</b> What was the time between bid tab approval and certification of requisitions for purchase?</p> <p><b>4.15</b> Was there a time delay between Company's advise date to purchase and client's approval?</p> <p><b>4.16</b> Were any manpower problems experienced in:</p> <ul style="list-style-type: none"> <li>• filling requirements?</li> <li>• assigning people?</li> <li>• performance of people?</li> <li>• attrition?</li> </ul> <p><b>4.17</b> Were original instrument nozzle orientations</p> |                 |                  |  |
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|---|------------------------------|------------|
| <p>basically correct with few revisions required?</p>   |                              |            |
| <p><b>4.18</b> Is there a regular coordination meeting with the project / engineering management and other lead engineers, including planning and cost control?</p> |                              |            |
| <p><b>4.19</b> Is there evidence of good communication with other disciplines / departments?</p>  |                              |            |
| <p><b>4.20</b> To what extent and by whom are the planning, cost and engineering managers informed when changes and / or slippages are encountered?</p>             |                              |            |
| <p><b>4.21</b> Is the specification / requisition tracking report regularly updated?</p>  |                              |            |
| <p><b>4.22</b> Is the mechanical equipment lead engineer involved in capital expenditures review?</p>   |                              |            |
| <p><b>4.23</b> What is currently the percentage of agency personnel on the job within the mechanical equipment group?</p>   |                              |            |
| <p><b>4.24</b> On the planning list how do the actual dates "for bids" or "for purchase" relate to the original schedule date?</p> <p>State slippages if any.</p>   |                              |            |
| <p><b>4.25</b> Is / are a local client resident engineer(s) present?</p> <p>Does he / do they have authority for on the spot decisions?</p>                         |                              |            |
| <p><b>5. Additional Questions</b></p>   |                              |            |
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## Product Audit Checklist

Note:

Any major deviation from requirements shall be tagged in the 'No' column and be elaborated on in the main report under Product Audit Findings.

Documents reviewed:

| Questions   | YES | NO | NA |
|---|-----|----|----|
| 1. Are input data available?  |     |    |    |
| 2. Have they been formally issued?  |     |    |    |
| 3. Have the data been qualified? (what is/is not included)  |     |    |    |
| 4. Have they been screened for completeness?  |     |    |    |
| 5. Have calculations been performed?  |     |    |    |
| 6. Have these calculations been checked?  |     |    |    |
| 7. Has the product been formally checked?   |     |    |    |
| 8. Is checking evidence available?  |     |    |    |
| 9. Do the issued documents contain sufficient information?  |     |    |    |
| 10. Have multi-discipline input/comments been obtained?   |     |    |    |
| 11. Are the issued documents checked for compliance with client, licensor and authority specifications?                                     |     |    |    |
| 12. Have all deviations from client, licensor and authority specifications been discussed and formally agreed upon with the relevant party? |     |    |    |
| 13. Are supplier data included in the document?   |     |    |    |
| 14. Have supplier data been qualified?  |     |    |    |
| 15. Have all requirements of the document been covered?   |     |    |    |
| 16. Have the document requirements been discussed with the internal client?   |     |    |    |
| 17. Have the document requirements been discussed with the external client?   |     |    |    |
| 18. Have any comments been received on earlier issues of the document?  |     |    |    |
| 19. Have all comments been incorporated in later issues?  |     |    |    |
| 20. If not, has agreement been reached about the implementation of comments?  |     |    |    |
| 21. Have changes been clearly indicated?  |     |    |    |
| 22. Has the PM or EM been involved in this discussion in case of comments from the client?  |     |    |    |
| 23. Has the document been reviewed by the discipline manager or his delegate, if required?  |     |    |    |
| 24. Has the document been formally approved at the proper authorization level?  |     |    |    |