Best Practice # 231

Facility: Multiple

Best Practice Title: Welding Requirements Flow-down

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Brief Description of Best Practice: This practice addresses the recommended welding flow-down requirements from engineering and facility owners to their internal welding/maintenance workforce, suppliers, venders/sub-venders, as well as contractors/subcontractors onsite and offsite. Welding requirements flow-down is described as follows:

> **T**he communication of engineering requirements to help ensure that weldments and systems meet or exceed the design requirements as specified by the organization.

Recommended Practice: The following actions and activities should be considered in conjunction with the flow-down of welding requirements:

1) When releasing a work instruction for a weldment or welding activity, the following requirements should be clearly defined in the organization communication.
   - Design codes and standards
   - Welding codes and standards
   - Non-destructive examination (NDE) requirements
   - Welding details
   - Special welding requirements or order of operation

   Design codes and standards

   > These are the applicable codes and standards that the weldment is designed in accordance with. These can be an established design code such as American Society of Mechanical Engineers (ASME), American Welding Society (AWS), or Pressure Equipment Directive (PED), etc. Welding requirements can also be in accordance with custom approved engineering standards. In the rare event that design code and standard requirements are not applicable, or an exception is being made, it shall also be specified by the engineering owner and approved by the Welding Program Authority (WPA). The design code and standard requirements information should be incorporated as part of a drawing note and part of the purchase order or internal work release.

   Welding codes and standards

   > These are the applicable welding codes and standards that apply to weldments or welding activity. The design codes and standards drive welding code and standard

requirements. For example: A piping system designed in accordance with ASME B31.1 Power Piping Code, would require use of ASME IX certified/qualified welding procedures and personnel. In the rare event that welding code or standard requirements are not applicable, or an exception is being made, it shall be specified by the engineering owner and approved by the WPA weld engineering owner. Welding code and standard requirements information should be incorporated as part of a drawing note and part of the purchase order or internal work release.

Non-destructive examination (NDE) requirements

Driven by the design and welding codes/standards, the rigor and frequency of NDE shall be specified by the engineering owner for a weldment or welding activity. Detailed NDE requirements for pre-welding, in-process inspections, and post welding shall be included in the instruction. For example: A girth butt weld on an ASME VIII Boiler & Pressure Vessel Code vessel may require the following: A fit-up inspection prior to welding, an in-process root visual inspection, then final visual, and radiographic inspection. In the rare event that NDE code or standard requirements are not applicable, or an exception is being made, it shall also be specified by the engineering owner and approved by the NDE engineering owner. The NDE requirements information should be incorporated as part of a drawing note and part of the purchase order or internal work release.

Welding details

Driven by the design codes/standards and the welding application, the types of welding joint configurations and final welded sizes shall be specified by the engineering owner. Welding codes and standards have pre-approved welding joint configurations, fillet weld sizes, allowable reinforcement, and many other conditions may need to be detailed on a weldment or welding activity. These details should be communicated with welding symbols, drawing notes, or a combination of the two. Welding symbols to be used should be in an organization-approved, standardized format such as AWS D2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.

Special welding requirements or order of operation

Dirven by finish conditions, a specific welding process selection or a specific welding order of operation shall be specified by the engineering owner. Additional requirements may be specified for distortion control or conditions where it would be more difficult to access an area after another step has been completed. For example: Foreign Material Exclusion (FME) is to be conducted on an ASME VIII Boiler & Pressure Vessel Code vessel before the last vessel head is welded in place. Any special welding requirements or specific order of operation should be incorporated as part of a drawing note and part of the purchase order or internal work release.

2) It is recommended that the following departments, assigned by the organization, review and approve the welding flow-down requirements prior to release for fabrication, installation, repair, or construction activity.

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- The engineering owner
- The Welding Program Authority
- The non-destructive examination owner
- The procurement and work planning and control (WP&C) owners
- The site personnel, contractor, and supplier owners
- The industrial hygiene (IH) and environmental safety and health (ES&H) owners

Engineering owner

The engineering owner is responsible for the design and design safety of the finished product to be produced. It is recommended that the engineering owning organization rely on the other departments for technical advice related to welding. Through communicating design information to the other owners, a sound plan for weld requirement flow-down will be established. It is recommended that the engineering owner should be the primary point of contact for the other departments.

Welding Program Authority

The WPA is responsible for the certification, review, and approval for welding applications. Working with the engineering owner, the welding flow-down requirements shall be reviewed and approved in accordance the design code and standard requirements.

Non-destructive examination owner

The NDE owner is responsible for NDE requirements for the certification of the product to be produced. Working with the engineering and weld engineering owners, the NDE required for the welding flow-down requirements shall be reviewed and approved in accordance with the design code and standard requirements.

Procurement and WP&C owners

The procurement and WP&C owners are responsible to the purchase order (PO) and work release for the welding activity. Working with the information provided from the other owners, the PO and work release shall incorporate approved welding flow-down requirements.

Site personnel, contractor, and supplier owners

The site personnel, contractors, and supplier owners are responsible for actual application of the welding activities. Working through purchasing and WP&C, these owners shall review and approve the welding flow-down requirements for applicability and contract requirements.

IH and ES&H owners

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The IH and ES&H owners are responsible for environmental, personnel, and bystander safety related to the welding activities. Working with all the owners, they shall review and approve the welding flow-down requirements for safety and exposure conditions.

3) It is recommended that a formal method or procedure be established to conduct welding flow-down requirement review, approval, and communication. This method should include the following:

- Technical approval structure that includes all owners
- Standard method of weld symbols and drawing notes
- Standard method of PO and WP&C communications
- Formal SharePoint or filing system to save and log welding flow down requirements for record and review

Why the Best Practice was used: The benefits of performing the activities defined herein can lead to:

- Improved safety performance
- Increased technical accuracy
- Improved quality and scope control
- Elimination or reduction of weld rework
- Intended quality delivered the first time
- Stronger cost quoting and fewer change orders
- Establishing transparency and consistency
- Cost and schedule compliance
- A positive public image and performance reputation relative to overall quality

How the success of the Best Practice was measured: When welding requirements are not flowed down from engineering to the application, it can lead to rework, change orders, confusion, and a product that does not meet the design safety requirements. Establishing a formal method of welding flow-down requirements review, approval, and communication will help to ensure design, NDE, weldability, and safety are considered by the responsible owners upfront. Through this collaboration, there should be a reduction in rework, an increase in on-time delivery, a reduction in change orders, and an overall improvement in defendable design safety.

Description of process experience using the Best Practice: This best practice is based on feedback and lessons learned from members of the DOE EFCOG Welding Task Team. Task Team members include Site Welding Program managers, Welding Engineers and Specialists. The recommendations provided herein represent their collective experience with Subcontractor welding activities throughout the DOE Complex.

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Proper review and assessment (vetting) of welding flow-down requirements, by organization assigned owners, are critical to the successful communication of welding flow-down requirements within the DOE Complex.