

Best Practice #162

Best Practice Title: Improving the Quality of Subcontractor Welding

Facility: Multiple

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Brief Description of Best Practice: The EFCOG Engineering Practices Welding Subgroup met to define the key elements of an effective welding program. These are:

Improving Quality Prior to Fabrication:

- The quality expectation must be established. Many of those involved in the procurement of welded items have limited code (governing welding codes and standards) knowledge. A face-to-face meeting between the Buyers' welding professional and the Vendor is necessary to ensure the Vendor is aware and cognizant of all applicable code requirements and to ensure the quality criteria and expectations are understood; email correspondence alone is not sufficient to establish this understanding (See attached Table for guidelines).
- The qualifications of all welding and Nondestructive Examination (NDE) vendors should be evaluated. If the vendor is outsourcing the welding or NDE, these sub-vendors should be present at the face-to-face meeting noted above.
- Welding and NDE vendor qualifications should be reviewed and approved by both the welding professional(s) and the quality assurance (QA) organization.
- When the expectations are understood, and the vendor documentation (procedures and qualifications) approved, the work can commence.

During Fabrication:

- Compliance to all welding fabrication requirements, including acceptance criteria, is essential.
- Surveillance and verification of compliance should be performed by a welding professional.
- Vendor production welding documentation should be reviewed by a welding professional.

Prior to Shipping the following should be performed:

- Complete qualitative and quantitative technical verification of all welding documentation.
- 100% visual verification of all welds by a qualified welding professional. Note – this is an "information only" activity, not a formal inspection or matter of record.
- Suspect welds flagged for further evaluation.
- Corrective actions completed.

Why the Best Practice is used: Subcontractor welding quality issues are at times encountered throughout industry, including within the DOE Complex. The first "EFCOG Contractor Alert", issued in 2005, had to do with welding deficiencies, including those of subcontractors. One of the key reasons for this is that many of those responsible for the procurement of items fabricated by welding simply do not have the technical background needed to specify appropriate controls and requirements for these activities. Welding engineers and specialists, who are familiar with these requirements, are typically not invited

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or required to take part in this process. As a result, procured or subcontracted welded fabrications often lack the quality needed to meet specified requirements.

What are the benefits of the Best Practice: In order to fully understand the benefits of implementing the above welding quality recommendations, consideration within the context of the Earned Value Management System (EVMS), which applies to DOE work, should be given. The benefits of a robust, effective welder subcontractor program can include:

- Reduced safety risk;
- Increased technical accuracy;
- Improved quality and scope control;
- Elimination of redundant inspections and NDE;
- Intended quality delivered the first time;
- Cost and schedule maintained within the originally forecasted EVMS model;
- Maintaining the project's fiscal budget allocation schedules; and
- A positive public image and performance reputation relative to overall quality.

What problems/issues were associated with the Best Practice: Welding professionals (engineers and specialists) are typically not included in the preparation, review and approval of procurement documentation for items fabricated by welding; these activities are typically left to procurement or quality personnel. As a result, the documents, and procurement activities (subcontractor facility review/ assessment, audit, etc.) usually lack the kind of plans, controls, practices and acceptance criteria needed to ensure required quality of the purchased items.

The lack of involvement of welding professionals in this process has and will continue to result in the procurement of items fabricated by welding that fail to meet quality requirements for use at facilities within the DOE complex.

In EVMS, all parties involved have a share in the cost of poor weld quality:

- Added risk is the most important aspect. If scope is extended due to rework, all parties have additional man-hours to be worked, impacting cost and schedule. In addition, expanded scope can carry an increased safety risk.
- Contractors and subcontractors faced with rework must re-figure cost/schedule, and will likely be explaining "how this happened" which can impact their or the Departments' reputation. Many hours can be spent addressing Nonconformance Reports (NCRs), Construction Deficiency Reports (CDRs), corrective actions, and extent of conditions that can easily create negative variances to the EVMS – variances or costs that cannot be recovered.
- DOE will be subject to soft costs that may be unrecoverable. These costs may include the need to add staff to address resolution of the NCRs and CDRs, and root cause studies, and delays to future work and fiscal budget impacts.

How the success of the Best Practice was measured: Application of the recommended steps has been shown to reduce the risk posture to the facilities and projects under the DOE. Specifically less rejections, reduced rework costs and NCRs are shown where the key elements listed in the brief description above are implemented. Ultimately, the success is measured with improved earned value on elements involving subcontractor welding.

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Description of process experience using the Best Practice: This best practice is based on feedback and lessons learned from members of the Welding Subgroup. Subgroup 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.

The most important elements that ensure the quality of procured welded fabrications include a technically sound contract, an appropriate product acceptance plan, and qualified welding professionals monitoring the process from cradle to grave. Engineering should work with Quality and Procurement in the development of specific rules and practices associated with these elements and then provide assistance with their implementation.

This best practice is directly tied to Integrated Safety Management System (ISMS) developing controls and performing work. It also touches other elements of ISMS when properly controlled.

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Attachment: Program Requirements for Procured Welded Items [1]

Quality level [2]	Welding is a critical attribute	Audit/Review of welding required	Weld submittal review	Weld oversight	Weld inspection	Receipt inspection for welding
Q Quality Related	Yes ^(a)	Yes ^(c)	Yes	Yes	By vendor	Yes ^(f)
	No ^(g)	No ^(g)	No ^(g)	No ^(g)	No ^(g)	No ^(g)
CM Commercial Grade	Yes ^(a)	Yes ^(c)	Yes	Optional ^(e)	By vendor	Yes ^(f)
	No ^(g)	No ^(g)	No ^(g)	No ^(g)	No ^(g)	No ^(g)
Risk Significant	Yes ^(b)	Yes ^(d)	Yes	Optional ^(e)	By vendor	Yes ^(f)
	No ^(g)	No ^(g)	No ^(g)	No ^(g)	No ^(g)	No ^(g)

Notes:

- a) Welding/NDE requirements in accordance with the applicable codes, specifications, and purchase orders evaluated for compliance to level of desired quality.
- b) Welding/NDE requirements established in data sheets, equipment specifications, or other design output documents shall be reviewed for determination.
- c) Supplier evaluations by the buyer's subcontract technical representative to include review of supplier's welding and NDE program and implementation.
- d) At a minimum, a review of the supplier's welding program and implementation by the buyer's welding lead.
- e) Whether formal oversight is provided by the buyer's Subject Matter Expert (SME) will depend on the complexity, dollar value, application, etc., of the item(s) being procured. This determination will be made by the cognizant welding SME and/or responsible design engineer.
- f) Performed by buyer's designated SME. The person performing the inspection shall be an individual who is qualified to determine the item(s) are compliant to all applicable codes, specifications, and purchase orders.
- g) Shall be approved by the responsible design engineer and welding/NDE SME.

[1] This table illustrates one approach to assigning actions and responsibilities that may be used to ensure the quality of procured, welded fabrications.

[2] These terms represent various levels of quality and may be defined specifically/unique for the needs of the specific program for which this type of table is used.