Welding Best Practices Survey

TE-110401

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April 29, 1999

Principal Investigators:
David W. Gandy
Michael K. Phillips
Neal Chapman
William F. Newell, Jr.

Prepared for:
RRAC Subscribers

Prepared by:
EPRI Repair & Replacement Applications Center (RRAC)

EPRI Project Manager
Shane J. Findlan

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ORGANIZATION(S) THAT PREPARED THIS DOCUMENT

EPRI Repair & Replacement Applications Center (RRAC)

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Report Summary

Welding Best Practices Survey

The *Welding Best Practices Survey* is a review of utility nuclear welding programs for repair and replacement activities. This publication provides a summary of the results from in-depth surveys performed at 13 RRAC member utilities. This information is intended to provide details on the methods and approaches used by these utilities to support effective and efficient welding programs at nuclear sites. Although differences in regulatory environment, plant sites, equipment and personnel may influence what is considered a “best practice” for each utility, this evaluation does provide valuable insight for a utility engineer/manager who is responsible for maintaining a Section XI welding program.

Background
Throughout United States, utility Welding Programs utilize a variety of methods to maintain and repair nuclear power plant components under stated Code and regulatory requirements. Regardless of how diverse they may be, all domestic nuclear welding programs are required to meet ASME requirements found under Section IX-Welding and Brazing and Section XI - Inservice Inspection of Nuclear Power Plant Components for repair applications. Each utility, and sometimes each plant site, has developed different methodologies to meet these requirements. In doing so, good practices have evolved to meet individual utility needs.

Objectives
The purpose of this project was to assemble and conduct site surveys to examine each RRAC Subscriber’s Welding Program and to identify the “best practices” implemented by the member utilities and areas for improvement. The information from these surveys is available to the RRAC members to assist in reviewing or enhancing the performance of their individual welding programs.

Approach
One or more subject matter experts (an RRAC staff member and a Utility Program Owner) conducted the *Welding Best Practices Survey* during a one to one and one-half day interview with the site’s Welding Program Owner. Prior to the interview process, a Preliminary Information Form along with a copy of the Survey was forwarded to each Program Owner for review. The interview process involved completion of the survey along with detailed discussions concerning each Owners program and philosophy. During the interview, the subject matter experts identified various Best Practices, which were compiled along with the results for other site surveys into this document.

Results
The results of the summary document can be utilized by RRAC Subscribers to improve and streamline certain areas of their existing welding programs. Examples of improvements which could be expected may include items such as: 1) the use of computer software for internal tracking of welders and welder qualifications, 2) procurement and control of filler metals, and 3) use of FCAW/GMAW processes. Another function of the survey was to identify areas where utilities can agree on common practices and highlight future research needs. Project deliverables include: 1) a workshop to review the task results, 2) this document summarizing the practices that were found to consistently and effectively meet Code and regulatory requirements and 3) a publication to provide information from follow-up interviews and implementation of these results.

EPRI Perspective
One of the major goals for nuclear utilities is the reduction of O&M costs associated with plant repair, maintenance, and life extension. To adequately meet this goal, utilities need to examine a broad range of opportunities for improved operational efficiency and cost reduction. The Welding Best Practices Survey supports this goal by providing information to assist member utilities to improve the value of welding related repair activities. This is accomplished by enhancing the performance of their nuclear welding programs through collaborative experience.

Project
Work Order 3887 and 5899
EPRI Project Managers:
Shane Findlan, Repair & Replacement Applications Center

Principal Investigators:
David W. Gandy & Michael Phillips, Repair & Replacement Applications Center
Neal Chapman, New York Power Authority
William F. Newell, WF Newell & Associates

Section 1
Introduction

Throughout United States, utility Welding Programs utilize a variety of methods to maintain and repair nuclear power plant components under stated Code and regulatory requirements. Regardless of how diverse they may be, all domestic nuclear welding programs are required to meet ASME requirements found under Section IX-Welding and Brazing and Section XI - Inservice Inspection of Nuclear Power Plant Components for repair applications. Each utility, and sometimes each plant site, has developed different methodologies to meet these requirements. In doing so, good practices have evolved to meet individual utility needs.

The purpose of this project task is to assemble and conduct a site survey to examine each RRAC Subscriber's Welding Program to hopefully identify "Welding Best Practices" and areas for improvement. Specifically, a number of subject areas examined during the survey including:

- Welding Program Basis
- Corporate Support, Staffing, Philosophy
  —Program Organizaitional Responsibilities
- Weld Filler Metal Control
- Training, Qualification, and Communication
- WPS/PQR Issues
- WPS Assignment and Field Uses
- Welder Qualification Issues
- Purging
- Postweld Heat Treatment
- Non-Traditional Practices

The "Welding Best Practices Survey" was conducted by one or more Subject Matter Experts (an RRAC staff member and a Utility Program Owner) during a one to one and one-half day interview with the site's Welding Program Owner. Prior to the interview process, a Preliminary Information Form along with a copy of the Survey was forwarded to each Utility Program Owner for review. The interview process involved completion of the survey along with detailed discussions concerning each Owners program and philosophy. During the interview, the Subject Matter Experts identified various Best Practices which were compiled, along with the results for other site surveys into this "Welding Best Practices Survey—Interim Results" document.

The results of the summary document can be utilized by RRAC Subscribers to improve and streamline certain areas of their existing welding programs. Examples of improvements which could be expected may include items such as: 1) the use of computer software for internal tracking of welders and welder qualifications, 2) procurement and control of filler metals, and 3) use of FCAW/GMAW processes.

Another function of the survey was to identify areas where utilities can agree on common practices and highlight future research needs.

Through November, 1998 at total of 13 utilities were surveyed and include:

Alliant-IES Utilities, Inc.
APS
CEI
GPU Nuclear
NiMo
NYPA
Peco
PGE
PP&L
SONOPCO
TU Electric
TVA
Wolf Creek

Project deliverables will include: 1) a workshop to review the task results and 2) a report summarizing the practices that were found to consistently and effectively meet Code and regulatory requirements.

Section 2
Welding Program Basis

The purpose of this section is to establish the regulatory design and operating basis, the specific code, year and addenda of the plants surveyed, and to determine the extent to which their license controls welding at the plant site. By us knowing what the licensing basis and controlling program documents are, the surveyors and the plant representative could reference the proper documents upon which to base survey responses. This data will also help EPRI RRAC Project Managers develop implementation procedures for future products when it becomes obvious that some plants may have to perform a 10CFR50.59 justification when implementing changes.

Guiding Documents

The guiding document for welding activities at an overwhelming majority of the plants surveyed was the Site General Engineering Specification or a Site Welding Manual. In all but two cases these documents reference the FSAR or USAR as the top tier or invoking document. In most cases the FSAR/USAR simply states that welding will be controlled and performed in accordance with the requirements of ASME Section III and/or ANSI/USAS B31.1. ASME Section XI is referenced for Repair and Replacement activities on ISI components. This is a **best practice** because changes can be easily made to the welding program or procedures without having to amend the FSAR. In the other two cases, the FSAR addresses the welding program in considerable detail. Those using this practice must continuously submit 10CFR 50.59 justifications to make changes to their welding program. The other drawback to this practice is that any violation in welding activities also becomes a violation of the FSAR. None of the utilities surveyed stated that their Technical Specifications were the basis of their pipe or structural welding activities. Most said that there was no Tech Spec reference at all to welding, two stated that the Tech Specs directed them to the General Engineering Specification.

The survey asked for the date of the construction permit in order to establish the code year for repair and replacement activities. Of the 13 utilities surveyed seven have units with construction permits issued prior to 1971, six have units with construction permits issued between January 1, 1971 and July 1, 1974, and four have units permitted after July 1, 1974. The significance of these construction permit dates is that they establish the design and fabrication code and code cases for the Class 1, 2, & 3 components. The correlation between the construction permit dates and applicable codes are as follows:

Construction Permit Date	Piping Code	Vessel Code
Prior to 1/1/71	ANSI/ASME B31.1 w/Addenda.	ASME Section III, VIII.
1/1/71 to 6/30/74	ANSI/ASME B31.1 and 31.7	ASME Section III,
7/1//74 and Later	ASME Section III	ASME Section III

The survey also asked for the operating license date for each unit. The purpose of this question was to establish the current 10-year ISI interval. The survey results indicate that five members have plants operating in their third interval, seven have plants operating in their second interval, and five have plants operating in their first interval.

Welding Program Scope

A group of questions were asked which sought to define the scope of the welding program on a particular site, and to determine where the control or jurisdiction of the nuclear welding program ended. In general, anything welded outside the security fence was outside the control of the welding program. If the fabrication shop or weld test shop was outside the fence they were also generally controlled under the blanket of the program. In a couple of cases if welding was performed outside the fence, the welding was performed under the program only if the material was issued from the issue station under a work order. Security modifications such as welding performed on fences and camera towers are performed under the program with certified welders and filler materials. A couple of plants do not perform security modifications under the welding program but do require certified filler material to be issued from the issue station with a rod slip.

When asked how non-code welding is controlled, most stated that welding was performed by qualified welders only. Welders who are not qualified cannot be issued filler materials. In several plants, welders who are training or practicing and are not certified must be issued rod by the test supervisor through the use of a rod slip. An exception to this standard practice is welding of equipment in the motor pool and grounds maintenance facilities outside the security fence.

No best practice could be established in this regard as each unit had good reasons for doing what they were doing and no clear cut cost savings could be established in any case.

Welding Program Owner Experience

The last question in this section addressed welding related experience of the Welding Program Owner being surveyed. The background and experience of those responsible for the welding program varied considerably.

Eight utilities have WPO’s who have been involved with welding and the welding program at their utility for ten or more years. In general these WPO’s are engineers with welding or materials engineering background and are well respected by those in their field, often being consulted on welding and ASME Code issues. Most said that they could pass a fundamental welding test. Many of these WPO’s are, or are approaching 55 years of age or older.

Three utilities have WPO’s that have been in this position, or have the welding program responsibility, for three to ten years. This group is generally engineers who have formal Materials or Mechanical Engineering training. Two WPO’s had the opportunity to learn from someone who has moved up in the organization and is still available for consultation

Two utilities surveyed have WPO’s who have been assigned this responsibility in the past three years, one only a day before the survey. Both have been asked to coordinate the welding program and rely on internal staff or consultants for technical support. The survey communicated a slowly moving trend that utilities are moving in this direction as key welding staff is promoted higher into the organization or reach retirement age. With aging plants this is a concern that should be closely monitored by plant management to see that the welding program maintains a strong technical presence, vital to the maintenance and repair and replacement activities of an operating plant.

Section 3
Corporate Support, Staffing, Safety, Philosophy--Program Organizational Responsibilities

This section of the survey is separated into major categories including: corporate support/staffing, corporate philosophy, computer software, current and future welding issues.

Corporate Support/Staffing

Overwhelmingly, Welding Program Owners (WPOs) believe that site management does support the utility/site welding program. This was evidenced as many WPOs confirmed that they were made a part of the team: 1) when repair and replacement activities were being planned and implemented, 2) when materials failure issues arose, and 3) through management's support of professional development. Another piece of evidence indicating that management supports the utility/site welding program is apparent in that each company stands firmly behind involvement in the RRAC.

Nine of twelve companies indicated that Corporate Metallurgists were available to support company materials issues. Surprisingly, however, only five organizations reported that a Corporate Welding Engineer was part of the company structure. The remaining seven suggested that the Welding Manual controlled onsite welding functions or welding was handled on a site basis by a site engineer who was responsible for the individual site program; hence a Corporate Welding Engineer was deemed unnecessary within the organizational structure.

In terms of welding staff (weld planners, etc.) 10 of 13 WPOs believe that their programs are adequately staffed for both today and for the future. However, it was readily apparent that welding programs, like many other functions within a utility, are only one deep at most positions (lack of succession planning). Out of 14 responders, only one WPO indicated that they have a protege (or trainee to fulfill some of the WPOs duties), whereas in the past slightly more than one half reported a mentor within the organization. This represents a lack of succession planning. WPOs reported the breakdown of their time spent on the following activities as:

Activity	Time Spent
Engineering	33%
Administrative	27%
Non-welding	23%
Training	>5%
Other	>5%

It is interesting to note that roughly 55 percent of the WPOs time is spent on adminstrative, non welding and training issues or items.

WPOs also suggested that they utilize the RRAC, peers, and personal networks for support and consultation. Specifically, the RRAC was indicated as a resource for developing products collectively. ASME subject matter experts are also relied upon heavily within each organization. Three sites suggested a good relationship with the ANI which was often used as another resource to address problems (particularly in the area of Code interpretation).

To supplement staff all but one utility reported that non-OEM engineering and onsite service organizations were employed. Organizations included: S&L, PCI Energy, WSI, Bechtel, Black & Veatch, DE&S, Nutech, Anchor Darling, GE, SIA, MPR, ProtoPower, O'Donnel Asso., and Continental Field Machine. All utilities indicated that staff augmentation (i.e., welding engineers, welding coordinators, welding supervisors, etc.) was used particularly during outages. Some augment from within (another plant), others go through a labor broker, and at least two responders indicated that they do not use staff augmentation.

Corporate Philosophy

WPOs were asked if their utility employed an OEM-first philosophy for component repair and replacement. Five responders stated yes, 8 stated no. Of those who responded positively, the comments ranged from: 1) we use OEM on some systems, but have become less reliant on them for many applications, 2) the OEM is not used on blind faith as they once were, 3) use of the OEM depends on the quality classification, if OEM supplied NSSS, utility will not touch it, 4) OEM used in most cases, to 5) no response.

WPOs were also asked to respond to how they viewed the future of their program. The responses varied from one end of the spectrum--we have a solid program now, but have no time to continue improving it to the middle--we are improving incrementally to the other end of the spectrum--change and flux within the program. Due to the varied responses, RRAC staff felt that it would be worthwhile to include all of the responses to this question as shown in the Table below. Five of the responses suggested that their organizations were looking to reduce paperwork, automate clerical duties, or streamline the program through computer databases and tracking.

How do you view the future of your program?
• Going to expand. Machine welding capability and procedure in-house is needed.
• Currently looking at software for trending--records, searches, etc. Program will continue to change—continuos enhancements. Maintenance shops are looking to obtain R-stamps. Growing new business.
• Uncertain; management wants to reduce paper and scope; must be brought under engineering. Currently adding to engineering staff because of previous staff cuts.
• It appears to be declining because it is not improving. Stagnant for last four years, just plugging holes.
• More automatic of clerical duties, more auto welding, more plant component ? related to service. More scrutiny by regulators. Better examination techniques influencing more repair.
• Going to streamline program through computer database. Must develop new people. Take advantage of Code simplification.

•	Growing concerns and needs due to aging plant.
•	Improving incrementally/N573/activity staying static
•	Solid program now, but no time to improve it. Software development utilization training of subordinates.
•	Currently in state of flux. Reducing staff. 2 programs consolidated into 1 (3 year process).
•	Planners scattered in 3 buildings - welders scattered.
•	Change. Personnel and program changes. Positive. Supported by management.
•	Will enter computer age for weld documentation preparation and filler metal control tickets. Program will be continually refined. Process and procedures updated.

Software

Currently, 10 of fourteen utilities employ some form of welding related software. The software identified included Turbo-9 (for reviewing welding procedures for adherence to Section IX), Welding Prowrite (for writing welding procedures), FilePro (database of filer material/weld installations), MS Word PQRs and procedures, in-house developed programs for filler material issue, and a MS Access developed welder qual. database to name a few. Several responders suggested they were looking to upgrade software and expressed an interest in Turbo-9, C-Mos, and other C-Spec software. When asked if WPOs thought software technology would be helpful to the welding program, WPOs suggested that software could help greatly in the areas of: 1) filler metal control, selection, and tracking, 2) welding data sheets and procedure writing, 3) intelligent checks on PQRs and WPSs (i.e., conformance to Section IX), and 4) welder tracking and performance.

An example (**Best Practice**) of the latter is PP&L issues a monthly *Trending Program/Report* to look at acceptable welds versus defects. Currently, rejection rate has been reduced at PP&L to 1 rejectable defect/1000 inches of weld or 1 rejectable defect/11 inches of weld (based on 70,000+ inches of weld). The report not only assists the Welding Engineer in tracking acceptance and required improvements, but also provides feedback to the welder on his performance. In other words, the program report provides trending information for both welding engineer (supervisor) and welder.

Another example of trending is that performed by CEI and PP&L. These utilities use trending to hire qualified welders from outside contractors.

Another software-related **Best Practice** was demonstrated by NYPA which has been using in-house software for 12 years in tracking filler metal and welder qualifications. The program provides reverse traceability by heat number, purchase order, Welder ID, and Work Request number. The same system is used to track welder qualifications, WPSs, and to generate WPQ reports. The WPQ are constantly updated by the Filler Metal Tracking Program in the NYPA program.

TVA utilizes an in-house developed database for capturing and updating welder qualification by linking the welder test qualification data and the weld metal requisition data, to continually update personnel welder qualifications (**Best Practice**). The system also provides reverse traceability. According to the WPOs for both NYPA and TVA, both systems could use some updating.

PECO is in the process of developing and refining the weld information system. This is a MS Access application which is being used to document and track field welding.

WCNOC uses a "MAPPER" database to control the welder qualification processing as well as the filler metal inputs used to update the process qualifications. WCNOC is looking to update the program as Information Services no longer supports the software.

PG&E utilizes a software database which was developed internally to track welder qualifications. The system has been in place for approximately 12 years. Its capabilities include tracking by Welder ID, work order number, and filler metal "trace" number. It represents the basis for process use and updating. One of the interesting features of PG&E's database is that the WQ has been through site QA. (Additional discussion will be added on PG&E software for the final document) (**Best Practice).**

At most utilities, the welding program is well recognized and is viewed at the same level as inspection functions within the organization. Welding programs fall under Maintenance (7) or Design Engineering (3).

In response to how are inspection requirements incorporated into your work package, WPOs responded in a variety of ways with the most common being the requirements are specified on the Work Data Sheet or Weld Travelers.

Welding Issues

The last area that was explored under Section 3 of the survey focused on Welding Issues. WPOs were asked to rank several welding/repair issues in terms of importance, to identify the three most pressing needs in the power industry, and to describe the three most recent welding issues faced. Table 3-1provides the results in terms of ranking (1-7 with one being the highest ranking) along with the averages of the responses with the lowest value being the highest ranking. As evidenced by the table, the number one and two issues are piping and nozzle repairs (including service erosion-corrosion) and balance of plant repairs/replacement. The next four issues (3-6) were somewhat equally ranked with only a few tenths of a percentage point separating them.

Table 3-1
WPO ranking of issues (1,2,3) in terms of importance the utility over the next three year period.

Rank	**Issues in Order of Importance**	
1	Piping and nozzle repairs—service erosion-corrosion	2.20
2	Balance of plant repairs/replacement	2.36
3	Valve repairs (including hardfacing applications)	3.55
4	PWHT issues (including Code relaxation)	3.63
5	RPV internal repairs (including irradiated materials)	3.80
6	SG repairs/replacement	3.83
7	Pump repairs	4.71

The three most pressing issues (or needs) identified by the survey included:

1) Lack of skilled welders
2) Welding of irradiated materials
3) Online repair technologies

Other needs identified included: 1) portability of welder qualifications, 2) welding under non-ideal/moisture present conditions, 3) shared PQRs and prequalified procedures, 4) lack of staffing and improvement in program, 5) PWHT exemptions, and 6) incorporation of code cases.

Table 3-2 provides a list of the three most recent issues faced by WPOs and their utilities. These issues which may not reflect best practices, they are incorporated for the reader to identify where common issues might exist with other utilities.

Table 3-2
A list of the three of the most recent welding issues faced by RRAC Subscribers

Utility	Fill in the blank
A	Replacing flex hoses in drywell. Welded in, not threaded. Circumferential cracking led to rejection.
B	Strainer mod (underwater), reactor water cleanup overlay, CuNi to stainless, statistics—QC issues, having contractors welding under program
C	Simultaneous weld qual maintenance with other utilities (bottom up frustration); welder proficiency; contracted service weld repair that did not give welding engineering sufficient time to perform weld; keep program from getting anymore diluted;
D	Hydrogen water chemistry and condensate filtration --just bulk of welding; welder proficiency; maintaining welder qualifications while they are gone--has some 41 welders—maintenance is big on keeping these guys on staff.
E	1. RWCU-46. 6" valve, no isolation, by pass leak 2. Cavitation on RB, closed loop cooling, High flow. 3 yr old CrMo 3. 10 MOV-34A - cavitation – erosion behind globe valve seat ring (16")
F	1) Condenser retube, 2) MSR, 3) Canopy seal reactor head, 4) Charged out last 2 rows of blades on LP turbine in place, 5) Sample line that could not be repaired, put layer pipe coupling over socket weld as temporary repair.
G	Qualification cards not being signed off. Undefined ? of program positions, implementation of Code ?
H	Water backed without pressure. Need for emergency WPSs. Correcting past problems.
I	Work control (failure to follow) setting skilled welders for outage.
J	E/C solved by overlays and inlays using various fillers to deal with each cause.
K	Set up formal training (test banks). Managing changes 416-1 and QC reduction and commitment.
L	Underwater welding qualifications, flux core welding, availability of skilled welders.
M	1) Pipe vibrating while welding prohibited crack-free fillet weld. Reduced vibration, cracking stopped. 2) CA6NM – Weld cracking problem. Had to soak in preheat. 3) Stellite 21 and Stellite 6 qualifications. 4) SWQT – ¼" Sch. 40 (.088 wall), x-ray weld. Problem with getting welders to pass.

Safety Issues

Special tungsten grinders have been purchased by a number of utilities to stop the practice of grooving standard wheels on bench grinders.

Fire watch requirements are fairly standard at all sites with one plant (WCNOC) posting separate fire watches at fuel gas bottles (in use) when they cannot be observed by the initial fire watch.

A majority of the plants responded appropriately by introducing fire retardant Anti-C's

Section 4
Weld Filler Metal Control

This section of the survey compiled information on weld filler metal control as it relates to procurement, storage, issue stations and personnel responsibilities, weld material requisitions, return policies and methods for return and discarding materials. Specific items such as holding and portable oven implementation practices plus comparison between clean and contaminated work area are also included. Differences utilized to maintain control of covered electrodes (SMAW), bare rod (GTAW) and spooled (GTAW-AU, GMAW, FCAW) consumables are provided where offered by the survey participants.

Procurement

Eight utilities procure weld filler metals as Safety Related Material only. The five remaining prefer to procure as Safety Related unless the material is not available. The practice of procurement on a Safety Related basis, when possible, is not new for all but one utility, and they switched to this practice about five years ago.

The more flexible approach (**Best Practice**) may be required as weld metal manufacturers and repair needs evolve to address emerging problems. Some consumables needed to address special needs may be produced by manufacturers who produce a satisfactory product, but do not operate or offer materials under a typical 10CFR50 Appendix B program. For example, the EPRI developed NOREM^{tm} welding alloy is not available in all product forms from vendors who possess or have maintained an "ASME III-type" or nuclear quality assurance program. A similar situation occurred during procurement of the special GTAW wire needed for steam generator repairs at Indian Point 2. In this case, the wire did not have a standard AWS designation (other than ER80S-G, but was produced to a German DIN Werkstoff Number) and was only available from a vendor who never had an "ASME Stamp" for low alloy materials. In such cases, audits have been conducted on the specific vendor and their product and manufacturing system approved.

In 11 cases, procurement criteria for welding filler metals is specified in separate administrative procedures while two utilities provide requirements within their welding program. Five of those surveyed indicated that they delegate this task as a procurement or warehousing function.

Weld Filler Metal Control Personnel Responsibilities Welding Engineer - Responsible for the overall effort at nine plants. At three plants, only specify procurement or just follow procedures. At one plant this function is controlled by others.

- Welding Supervisor - At nine plants, either none is on site or listed. In four cases, this position authorizes the issue of weld filler metal.
- Welder - All plants require them to maintain control of filler metal while in their possession and ensure correctness of issue documentation information.

- Warehouse/Issuer - At eleven plants they insure issue to proper personnel and maintain storage. At two units, storage only.
- Welding Foreman - Responsibilities range from verifying qualification, to selection of filler material to writing Weld Material Requisitions. At four facilities, this position specifically issues rod slips.

General Storage

All utilities surveyed indicated that their warehouses and rod issue rooms meet storage Level B requirements. Four of the units reported that even though not required, their rod issue rooms did meet Level B requirements. In one instance, the rod room is within the warehouse.

Issue Stations

The number and physical location of welding consumable issue stations varied widely among surveyed utilities. Under normal operation, five units only offered a single point of issue while another five provided consumable issue both inside and outside the Radiologically Controlled Area. In four plants, issue stations were also located in the weld test shop.

In 10 of the 13 surveyed, the issue station was located within or part of another room such as a tool crib. When asked if co-location caused access problems or confusion during busy periods, only two utilities indicated yes. At WCNOC and TU, weld rod issue stations were in completely separate areas.

WCNOC has taken the most rigid approach to filler metal control. Personnel are specifically trained for the task and maintain a very clean, organized (each item has a permanent label) area. Even though in a separate location, the issue area is designated and posted as follows: "Authorized Personnel Only", "Level B Storage", and "Quiet Zone". Non-work related personnel, discussion or distractions in the area are strictly prohibited, thus allowing issue personnel to focus on the task at hand. (**Best Practice**).

During an outage, eight units indicated that they implement additional issue points on the refueling floor underwater welding or for major activities in isolated locations such as a BWR torus modification. Five units indicated that they do not increase the number of station, but with one exception, these units maintain issue points both inside and outside the RCA. At CEI, delays and confusion are further reduced during busy times by issuing welding consumables to welders on critical path jobs on a priority basis (**Best Practice)**.

At PP&L, a main issue facility outside the protected area feeds satellite issue stations inside the plant in the main tool room/issue point as well as one in the hot machine shop. Thus they have the advantage of issue points both inside and outside of the RCA.   This approach reduces issue/return lost time within given shifts and provides an opportunity to reduce radwaste because "warm" welding electrodes could be reissued. (**Best Practice**).

Nine of the survey participants issue covered electrodes by the piece, while the remaining plants issue and maintain records by the pound. In all cases, bare rod is distributed by the piece.

GTAW rod was noted as being issued in 10-inch, 18-inch or 36-inch lengths, depending on the utility.

Issue Personnel

In all cases, those surveyed implement some form of access control for the issue stations or rod rooms. All locations are locked in some manner. Ten facilities post lists of personnel authorized to enter the area and/or issue weld filler material.

All issue personnel or rod room attendants receive some level of training. Ten of the survey participants require formal and documented training. This training typically involves two to four hours of classroom instruction plus four to eight hours of supervised on-the-job training (OJT). Of these ten utilities, three require a formal test. The three remaining utilities, however, only require informal and undocumented training or familiarization.

Individuals responsible for training weld metal issue personnel varied among those surveyed. Eight responses indicated that training was provided by the Welding Engineer or Welding Program Owner. One indicated the Tool Room Supervisor, one a QC individual and three respondents offered that any training instructor could provide training.

Issue personnel from six facilities were also required to verify that the welder was qualified and current to use filler metal for the WPS/process requested. In six other units, the foreman or supervisor performed this task while the Welding Engineer was responsible for this task.

Weld Material Requisition (WMR)

Survey results indicated that all utilities required the welder to maintain the WMR with the welding material and/or in the package and/or with the weld traveler or Work Order. The differing location requirements are summarized as follows:

WMR Location Requirement	# Utilities
Weld Metal & Package	2
Weld Metal Only	3
Weld Metal, then Package On Return	2
Package Only	4

In all but one case, the WMRs are reconciled at the end of each shift. All those surveyed permitted more than one weld to be listed on the WMR. Efficiency was stated as the major reason for this approach.

More than one WPS was permitted to be listed on a WMR by seven facilities. The ability to implement this flexibility is a **Best Practice**. Avoiding mix-up of fillers is stated as the major reason for not allowing this practice by the remaining plants. Since most of those surveyed permit multiple WPSs to be listed on the WMR, perhaps concerns over problems are unfounded.

Five plants permitted multiple welders to be listed on an WMR, except where process qualification updates were involved. Factors including confusion, software problems and

'…prohibited by procedure…' were cited by those who did not allow the practice under any circumstances.

Changes to the WMR, like adding a filler metal, welder or WPS, were permitted by eight of those surveyed. Changes to weld filler metal was cited as the most frequent item. One utility only permitted changing the WPS while another only permitted changing welders.

Issue Station Oven/Bin Identification and Temperature Monitoring

All surveyed identified the contents of holding ovens. The contents are identified by lot (covered electrodes) or heat (bare wire) number using lists or maps identifying specific items with respect to their location (oven or bin). Certified Material Test Reports, Certificates of Compliance or other test information are not located in the issue stations but are maintained elsewhere at the plant.

Two novel methods (**Best Practices**) for tracking specific lots or heats of material are used by PP&L and TVA. PP&L has credit card imprints for each heat and lot of material. The imprints are applied to rod slips, WMRs, etc. This method ensures that the specific heat or lot of material identification is legible. TVA "bar codes" all materials upon receipt, enters the information into a data base, then can track filler metal by welder ID, work package, etc. Data entry becomes only a matter of "swiping" and recording the code. Examples of these methods are shown in Appendix A.

All storage ovens are monitored with some form of calibrated temperature device. Most use thermometers. PP&L utilizes a data logger to monitor as many as 20 ovens. This advanced approach has been suggested as a **Best Practice**, however, unless some redundancy is provided, a failure in the recording unit could jeopardize the usability of the contents of all the ovens. On the other hand, the traditional less sophisticated individual mechanical devices (thermometers) tend to be very reliable and failure in their operation only affects a single oven. Frequency of calibration was split in the survey between six and 12 months. Only one utility indicated that they checked temperature readings and recorded them on a daily basis.

Storage of austenitic and nickel base covered electrodes were similar, except one utility did not require they be maintained in heated ovens. For domestic electrodes with -15 or

-16 coatings, room temperature can be acceptable, but 120 to 200F is usually adequate. The -17 formulations, once removed from their hermetically sealed container, require storage at 250 - 300F to avoid starting or centerline porosity. Plus, storage at this temperature beyond about six weeks is not typically recommended by some manufacturers. Fortunately, regardless of the coating formulation or holding time, excessive moisture in these electrode coatings typically only result in very obvious starting or centerline porosity. It should also be noted that unlike many carbon and most low alloy carbon steel electrodes, these electrodes do NOT have low hydrogen-type coating formulations.

Welding Material Exposure/Portable Rod Ovens and Heaters

Out-of-oven or exposure times for covered electrodes (SMAW) varied from one-half hour to 12 hours with no reported problems, depending on the electrode and utility. Six facilities indicated

10 to 12 hour exposure limits for E7018 while a few indicated from two to the traditional four hours. Exposures for low alloy electrodes also varied from one-half hour to 10 hours. Stainless steel and nickel base covered electrode exposures ranged from no limit to 10 hours. In most cases, the American Welding Society (or ASME clone) filler metal specifications, original construction specifications or past practice were cited as the basis for maximum exposure limits.

Survey data did not specify whether moisture or extra low moisture coating formulations were being used and thus it was difficult to properly categorize the information. Options are now available for coating formulations that tolerate much greater exposures than many of the consumables used during construction. However, it has been noted that as moisture resistance increases, operator appeal and tolerance to porosity may decrease depending on the alloy and manufacturers recipe.

Only TVA indicated that they use covered electrodes in vacuum packs. Use of such packaging (1 to 4 lbs. per package) can mitigate the need for holding ovens, provide go/no-go information on moisture control (if package is not broken, integrity is maintained), and provide a means for easy frisking, decon and removal of unused material (package unopened) from the RCA (**Best Practice)**. Vacuum packs are available as standard packaging from Electrode Engineering, Metrode and Lincoln Smitweld. Others offer such packages on a special order basis.

Nine utilities listed the use of spooled wire (GMAW or FCAW)and controlled them quite differently. Note that PP&L plans to use FCAW for over 70 percent of all their welding over the next year and one-half. Four users leave the spools on the wire feeders in locked enclosures and sign over control slips to the next shift (PP&L and TVA use this method successfully) (**Best Practice**).

DEAC uses a keyed interlock on GMAW equipment and allows spooled wire to remain on the machine. The key is the primary control feature and must be returned at the end of each shift or job in lieu of the spool.

Five plants required issue and return each shift. It was noted that where the material was issued in protective bags or containers, the spool or unused material and the protection had to be returned to the issue point. Most have not developed or specified criteria for control of flux cored or metal cored wires beyond perhaps storing on top of warm ovens when not in use. Two users are in the process of developing criteria while two more are just storing wires in a humidity controlled environment. Where low hydrogen concerns may be an issue, manufacturer's recommendations should be considered.

Issue and control of portable rod ovens also varied among survey participants. Eight plants issued them in accordance with their rod requisition/issuance program, while TVA used their bar codes. NYPA noted that they did not implement controls and they established a 10 hour exposure limit, whereas PG&E did not use portable ovens because they had established 10-hour exposure limits.

Five utilities use calibrated rod heaters, but did not specify whether the oven thermostat or thermometer was calibrated. Of those who did not require calibration, three checked temperature when issued with a temperature indicating crayon. Others just checked to see that they were "hot" or if the thermometer (if they had one) appeared to be working. If a thermometer was present, a small minority would check them on an annual basis only.

For over two decades, much positive overall experience has been observed with extended exposure times with the low moisture coatings, aside from some increased porosity attendant to the low moisture coatings in out-of-position welding. Specific positive experience with high strength low alloy electrodes (80 & 90-series) with low moisture coatings and vacuum-type packaging has been observed for about two decades in offshore platform applications. The impetus for vacuum packaging in the offshore arena was three-fold: 1) maintain moisture resistance and electrode coating integrity, 2) institute packaging that could survive the harsh environment while providing electrodes in limited quantity packaging consistent with "out-of-package" usage of electrodes, and 3) eliminate the need for holding ovens - stationary or portable. Because of the forgiving nature of today's covered electrode formulations, availability of low moisture coatings and alternate packaging not requiring ovens (vacuum packs), it appears that avoiding the use of portable ovens warrants serious review (**Best Practice**).

Filler Metal Return - Clean Areas

Weld filler metal is returned, accounting and recycling performed as follows (number of utilities shown:

<u>Counting</u>	
Count Stubs	5
Stubs returned but not counted	6
Count returned unused material	2
<u>Returns</u>	
Returned by pc./rod/stub	10
No returns SMAW	2
No returns GTAW	1
<u>Recycle (return & reissue)</u>	
Recycle SMAW	10
No returns, SMAW scrapped	2
GTAW back on shelf	1

The overwhelming majority (10) of those surveyed stated that "stashing" of welding filler metals in the plant or shops was not a problem. Three units indicated that they had some specific, isolated problems, but that they were resolved with appropriate management attention and training of personnel.

Filler Metal Return - Contaminated Areas (RCA)

Three utilities treat unused or partially used weld filler metal as waste and require radiation technicians to determine the status (**Less Than Desirable Practice**). Ten utilities frisk unused material at the step-off pad, treat contaminated material as radwaste and return clean material to the issue point. Where scrapped or returned to the issue point, rod slips or WMRs are adjusted accordingly.

Filler Metal Disposal

Used and unusable weld filler metal scrap is disposed of as follows (number of utilities shown):

	Onsite*	Offsite	N/S**
Dumpster/trash, no special controls	2	2	3
Dumpster/barrel, special controls (locks, welded shut, etc.)	2	4	

*None in RCA   **Not Specific

Note: A few utilities made final disposal a non-issue by using a dumpster located outside of the fence.

Nine survey participants use locked and pilfer-proof stub barrels. One response indicated that their barrels were locked, but not pilfer-proof and that the lock was for perception purposes only. Three utilities do not use locked or pilfer-proof containers, they use open barrels, bend or break rods and did not indicate problems.

Welder Familiarity and Certification

Most utilities indicated that their welders knew what filler metals to use and the reason(s) why. Collectively, factors including training, weld documentation and work travelers were cited as reasons for achieving satisfactory results. PP&L offered a very honest response in that they stated that their welders may not know what filler metal to use from a technical standpoint, but that they are normally familiar with a variety of applications.

When asked whether uncertified welders could be issued filler material, nine survey participants answered a "qualified yes", given limited conditions including: non-code work, practice, training, tool fabrication, soldering, etc. Four utilities responded negatively, without any exceptions.

Non-plant Equipment Applications

The building and ground staff at five plants have and maintain their own welding equipment and supplies. Eight responses indicate that where they do, the work is done outside the protected area for motor vehicle or heavy equipment maintenance or on non-permanent plant applications. Only two plants indicated that such welding would come under the jurisdiction of their welding program, but they would treat it a non-code or perform work outside the protected area. Three plants indicated that such work would not be conducted under their welding program.

Ferrite Criteria for Austenitic Stainless Steels

Delta ferrite requirements for austenitic stainless steel weld metal were cited as originating from three major categories: USNRC Regulatory Guide 1.44, NUREG-0313 Rev. 2, or original design specifications. The following table summarizes responses (number of utilities shown):

	Ferrite Number, FN		
	5-15	8min	Other
Reg Guide 1.44	2		
NUREG-0313 R2		2	
Design spec.	6		1@20max, 8min. ave. w/ 1@5min.
		1@5-9	
			1@8-25, except 5-15 for 309L

Appendix 4A -- Examples of Tracking

Section 5
Training, Qualification, and Communication

This section of the survey targeted a number of areas including training, shared/joint qualifications, and communication among welding program participants. To maintain consistency and to ease presentation, the section has been separated along these lines, with one exception. The subsection on training has been separated further to include discussions on welding staff/personnel training/qualifications and on welding craft training. The discussion begins with the former.

Welding Staff/Personnel Training/Qualifications

Survey participants were asked to identify qualifications, experience, and training requirements for the following positions:

- Welding Engineer
- Welding Coordinator
- Welding Planner
- Mechanical Planner
- Welding Supervisor
- Welding Foreman
- Warehouseman
- Rod Room Attendant
- Welder

The response from most utilities was that little or no formal structure or training program/requirements were established for many of the positions listed. The utility which came closest to having some structured level of training/requirements was TU Electric. Specific classes for each of the jobs including: Welding Supervisor, Welding Foreman, Warehouseman, and Rod Room Attendants have been established for personnel to attend before performing these jobs. Welder orientation and qualification tests have also been established for welders. Welding Planners and Mechanical Planners must be trained under another qualified planner for at least six months; however, no formal tests are in place for these two positions. TU does not have formal written requirements for the Welding Engineer or Coordinator. An example of the classroom training requirements has been attached in Appendix 5A.

APS has a unique training program which is geared toward the QC Inspector. The program boasts successful random QC and has allowed APS to reduce the QC staff over the past two years (more will be included on this topic at a later date). (**Best Practice**)

While on the subject of training requirements, survey participants were asked if they (or the positions described above) were encouraged to seek continuing education or training. Most utilities indicated no, only four said yes. Three of those answering yes indicated that further training/education was only targeted at engineering staff, while the remaining yes was for welder training only. This is an alarming trend and appears to represent the "short term" planning that our industry has embraced since the word deregulation became vogue. This represents a **Less Than Desirable Practice.**

DAEC does something that appeared to be unique in the area of training. Four welders are given 18 months of training at the local community college. (**Best Practice**) This training elevates their capabilities to such a degree that they can be considered Welding Foreman or Supervisors. The plant upgrades these welders to welding foreman status during outages and they supervise the contract craft welders. This concept should be viewed as an area for future consideration.

Out of the group of 13 utilities, eight utilities have Certified Welding Inspectors (CWI) on staff where the remaining five do not. At least one utility reported five CWIs on staff. Three Registered Professional Engineers were among the Welding Engineers polled, while one engineer was working toward that goal. Ten utilities indicated that either the Welding Engineer or the Welding Coordinator can pass fundamental welding tests, which suggests three cannot. Of the three remaining, all have welding experience on some level however.

An improved trend was exemplified when utilities were asked if they participated in the American Welding Society local sections. Nine indicated active participation. However, the trend was less favorable concerning participation in ASME. Only a few subscribers stated that they or someone in their group actively participated in ASME. GPU, SONOPCO, APS, PG&E, and TVA (and new member Ontario Hydro) actively participate in ASME Code activities which provides them with an excellent industry perspective and can impact present and future utility changes.

One final comment should be made concerning training—all respondents expressed that better training is the *key element* to the program's success.

Welding Craft Training

Survey participants were asked what forms of welding training were offered at their facilities. The following provides a brief overview by process:

- GTAW 8
- SMAW 8
- GMAW 5
- FCAW 5
- GTAW-AU 2

The values reported above may be artificially low however, since many utilities reported that training was implemented on an "as needed" basis. Participants were also asked if specialized training was offered in the following areas: pipe welding, hardfacing, overlay applications, or others. Nine stated that some form of specialized training had been or was being offered.

Exactly, one half of those surveyed indicated that welding equipment fundamentals were taught to welders, while 9 of 14 suggested that welders could determine the difference between CV and CC machines, OCV, or transformer versus inverter machines. Eleven utilities indicated that welders were trained to perform cutting operations with oxy-fuel or plasma gouging equipment/processes. It also appears from the survey that most welders are trained to differentiate when to use equipment with high frequency constant arc starting in constant versus start capabilities. Finally, one half of the responders suggested that welding symbols are taught to welders in a formal setting.

Peer Groups

The establishment of Peer Groups, the open sharing of ideas, concerns, challenges, responses, and planning is considered one of the **Best Practices**. PECO, NYPA, and TVA serve as model Peer Groups within the group of RRAC subscribers. Of the 13 utilities surveyed, six indicated that some form of Peer Group exists internally. Many of these groups meet at least once a month, while others indicated one to six times per year. Regular monthly meetings are supported by upper management to assure that information is shared and projects are continually pushed along.. For smaller utilities the concept of peer groups can be modified to include plant personnel with invited guests from surrounding utilities or related industries. The idea is to focus attention on this subject, in any size forum this is a significant benefit. Agendas for such meetings may include:

- Post problem discussions
- New problems or challenges
- Procedural quality and adherence
- New equipment, software, and processes
- Qualification of all levels within the welding program
- Cost awareness
- Educational presentation
- Safety concerns

PECO provided a "Draft" project plan which describes the charter of their Welding Council (See Appendix 5B). Specifically, it includes the charter, objective, and justification of the Council, Team members (resources), role of the Council, scope, and Council communications. Again, this is a draft and should be viewed as such. It serves as an example of what a Welding Peer Group charter may encompass. It should be further re-iterated that the document focuses management attention to the Welding Program and Peer Group.

Joint /Shared Qualifications

The final four questions of this section were targeted at sharing welder performance qualifications, joint procedure qualifications, and joint personnel training. The question was asked "Do you believe the industry should recognize transfer of welder performance qualifications performed under a nuclear quality assurance program? A resounding eleven utilities said yes, two indicated no. The reasons stated against transfer was "A person's ability can change due to personal conditions." This individual did indicate that control assurances or a Code Case could convince him to change is position. The remaining "no" flatly indicated that his utility's position was that they would not rely on other utility qualifications. GPU and PECO are pursuing sharing of simultaneous welder qualifications including multiple process updating of information.**(Best Practice)**

Survey participants were also asked how they would go about implementing joint welding procedure qualifications into their respective programs. The responses varied considerably from: 1) through licensing, to a relief request, 2) to must be addressed under the quality assurance program, 3) to modify welding program manual, 4) to no changes necessary. When asked "What changes would be required of each program to utilize a PQR qualified by another organization (which was performed under a nuclear QA program)" the responses were for the most part similar. Most indicated a Relief Request from the NRC would be required, while others stated it would be looked at on a case by case basis or would require revision to the Welding program manual.

Ten utilities stated that they believed the industry should support *joint personnel training programs* for such issues as: licensing to assist welding engineers, training on automated equipment, temperbead training, dry cask welding, welding equipment fundamentals, PWHT courses, etc.

NYPA is actively pursuing common qualifications through the union. (**Best Practice)** Twelve Saturdays per year, the union hold tests under their qualification program. These tests are funded by the local and supervised by NYPA. The tests are identical to those given by NYPA. Using guideance found in Section IX, NYPA adopts these supervised tests into the NYPA system to support welding onsite. These tests are given often enough that process currency is maintained in most cases. This system is estimated to have saved NYPA approximately 25 welder qualifications with each estimated at $750.

Newsletters

Newsletters, reminder cards, and responsibility placards are vehicles by which utilities can express expectations of all participants in their program. WCNOC uses "Stuff-to-think-about" cards which are placed with each weld package to reinforce management's expectations. PECO and NYPA have employ newsletters and GPU exercises safety alert bulletins.

Appendix 5A -- TU Electric Training Program

TU Electric

WLD Program Procedure Training Guide for Welders
(Mat Code TSB 8 WLD XD6)

(The purpose of this training is to provide an overview of the Welding Program at CPSES, the responsibilities of the welder, and the welder's qualification range(s) prior to performing welding on permanent plant equipment or systems.

1. Explanation of the Welding Program.
   a. Adherence to the requirements.
   b. Examples of what can happen if requirements are not followed.

2. Limits of Qualifications
   a. Cover the limits of each SWQT that the welder has passed.
   b. Code Qualifications
      1) ASME Section IX
      2) AWS D1.1/D9.1

3. Welding Procedure Specification (WPS)
   a. Read and understand pertinent information related to the required reading.
   b. Insure that the WPS listed on the applicable WDR is inserted in the work order package.
   c. Verify that you know the proper amps and volt range for the process being utilized.

4. Acquisition and proper handling of welding filler material (WLD-105)
   a. Required form, FMWA
      Enter weld joint ID number
   b. Two or welders using electrodes issued by one FMWA is strictly prohibited.
   c. Controlled issue points, locations.
   d. Verify type, size, and amount of filler material.
   e. Issuance of electrodes in Portable Electrode Ovens (PEO)
      1) Requirements for PEO while being used
      2) Check PEO for malfunction every few hours
   f. Exposure time for coated electrodes
      E7018 4 Hours
      E8018 2 Hours
      E9018 1 Hour
      E10018 ½ Hour

5. Weld Data Record (WDR) and Repair Process Sheet (RPS) Hold points
   DO NO BYPASS.

6. Base Materials
   Compare WPS requirements with WDR listing to actual base materials.

7. Weld Joint Preparation
   a. If flame cutting is employed on carbon steel pipe, the cut surface shall be ground to bright metal by mechanical means.
   b. Tools and types of materials to be used
      Requirements for stainless steel - fluorescent orange.
   c. Cleanliness requirements prior to welding
      1) A minimum of 2" on each side of the weld joint shall be degreased.
      2) A minimum of 12" on each side of the weld joint shall be free of moisture and dirt.
      3) Mechanical preparation shall result in a clean surface ½" minimum on each side of the weld joint before proceeding with fit-up.

8. Weld Joint Fit-Up and Alignment
   a. Inside diameter mismatch for pipe and tubing welds shall not exceed 1/16" for ANSI and non-code applications.
   b. Partial penetration welds maximum fit-up gap is 1/8". Fillet weld fit-up is 1/16". Fit-up gap that exceeds 1/16" shall have the weld size increased and documented. Maximum fit-up gap for fillet welds is 3/16"
   c. There shall be 1/16" + 1/32" root gap for flare bevel welds on 2" x 2" square tubing. The maximum electrode size used for the root pass shall be 3/32".
   d. Socket and Flange Fittings

9. Preheat
   a. For temperatures up to 100°F, a contact pyrometer shall be used; for temperature above 100°F, a contact pyrometer or a temperature indicating crayon (sticks) shall be used. Document contact pyrometer M&TE number on the WDR.
   b. The area to be preheated on any weld joint shall be a distance equal to the thickness of the part being welded, but not less than 3 inches in all directions from the point of welding.
   c. Temperature indication crayons, when used for preheat and interpass temperature measurement shall be applied outside the weld joint to avoid direct contact with the surface to be welded.

10. Welding Machines
   a. Proper grounding techniques
      1) The area of contact for the ground should be free of scale, rust, oil grease, oxides or dirt that could act as insulation.
      2) The ground connection should be attached to an item having adequate cross-sectional area to allow for current flow.
      3) The ground connection should be placed as close as possible to the weld joint to prevent possible arcing damage to equipment, pumps, valves, hangers or supports, etc.
   b. Proper ways to energize welding machines.

11. Purge Requirements

Purge requirements, if any, shall be performed in accordance with the WPS and WLD-106. Systems potentially hazardous due to presence of Hydrogen (H_2) must be checked for an explosive mixture prior to grinding or striking of the arc. The work order must be reviewed prior to the start of work for any cautions regarding Hydrogen in the system.

12. Welding Technique (WLD-106, par 6.9)

a. All full penetration groove welds shall utilize the GTAW process for the initial (root) pass and second pass/layer.
b. All groove welds, eg. flare V, flare bevel, and partial penetration welds shall be filled to the full cross-section of the weld joint.
c. All socket welds (fillets) require a minimum of 2 passes. Excessive welding on stainless steel socket welds will be cause for rejection and removal.
d. Specific weld sizes and dimensions for fillet welds shall be specified on the applicable documents. These specified weld sizes and dimensions are the minimum size acceptable.
e. Tack welds should be kept to a minimum number and size to secure the required fit-up. Tack welds shall be ground at the starts and stops of the weld.
f. Bead Width Requirements
GTAW & GMAW - 3/8" max., SMAW - 4 x electrode core diameter max.
g. Interpass cleaning shall be performed after every pass/bead has been completed. The interpass temperature check shall be performed when the base metal adjacent to the weld joint is suspected to be nearing the maximum interpass temperature.
h. Types of welds and welding related activities that are prohibited.
Dry washing, slugging, block welding on piping, and grossly overwelding a fillet weld. (expound)

13. Weld Finish and Reinforcement (WLD-106, par 6.12)

a. The final surfaces of all welds shall be free of sharp surface irregularities, porosity, cracks, laps, slag, arc strikes, spatter and abrupt changes. Undercut shall not exceed 1/32" and shall not encroach on the minimum required section thickness. On ASME Class 1 welds, no undercut is allowed.
b. Piping offsets shall be faired by welding to at least a 3 to 1 taper over the width of the weld.
c. The reverse side of full penetration welds shall be clean, smooth , and free of stalactites, bumps, slag accumulations, burn through and severe oxidation. The weld joints shall have no area of incomplete penetration of incomplete fusion.

14. Weld Identification (WLD-106, par 6.13)

a. ASME Weld Joints - Inscribe assigned weld joint number in an accessible area adjacent to the actual weld joint, prior to fit-up inspection.
b. Welder ID Requirements (ASME and Non-ASME) - Inscribe assigned welder ID# in an accessible area adjacent to the actual weld joint prior to final VT inspection.

15. Stringing out Welding Cable

   a. Suspend the cable(s) six feet above the walking pathways with plastic tie wraps. Spreading the cables on the floor will be a safety hazard.
   b. Do not connect the ground cable to any of the following:
      - Permanent plant equipment
      - Cable Trays
      - Conduit
      - Small copper ground cables with a diameter of less than ½"
   c. If there is no place for grounding - Contact Your Supervisor

16. Welding Safety

Electric shock can cause sudden death, injuries and fatalities if proper precautionary measures are not followed. Electric shock occurs when an electric current of sufficient magnitude to create an adverse effect passes through the body.

The risk of electrical shock is usually increased in the presence of water or moisture. When are welding or cutting is to be done under damp or wet conditions, including heavy perspiration, the welder must wear dry gloves and clothing in good condition to prevent electric shock. The welder should be protected from electrically conductive surfaces, including the earth, by rubber-soled shoes as a minimum, and preferable by an insulating layer such as a rubber mat or dry wooded board.

The work piece being welded and the frame or chassis of all electrically powered machines must be connected to a good electrical ground. Grounding can be done by placing the work piece or machine on a grounded metal floor or plated, or by connecting it to a properly grounded building frame or other satisfactory ground. Chains, wire ropes, cranes, hoists and elevators must not be used as grounding connector nor to carry welding current.

The work lead is not the grounding lead. The worklead connects the work terminal on the power source to the work piece. A separate lead is required to ground the work piece or power source work terminal. Terminals for welding leads and power cables must be shielded from accidental contact by personnel, and by metal objects, such as vehicles and cranes.

Care should be taken when connecting to the grounding circuit. Otherwise, the welding current may flow though a connection intended only for grounding, and may be of higher magnitude than the grounding conductor can safely carry. Special radio-frequency grounding may be necessary for arc welding machines equipped with high-frequency arc initiating devices.

Electrical connections must be tight and checked periodically for tightness. Magnetic work clamps must be free of adherent metal particles and spatter on contact surfaces. Coiled welding lead should be spread before use to avoid overheating and damage to the insulation.

Equipment, cables, fuses, plugs, and receptacles must be used within their current carrying and duty cycle capacities. Operation of apparatus above the current rating or the duty cycle results in overheating and rapid deterioration of insulation and other parts.

A welding circuit must be de-energized while the electrode, torch or gun is being changed or adjusted. One exception concerns covered electrodes with shielded metal arc welding. When the circuit is energized, covered electrodes must be changed with dry welding gloves, not with bare hands. In any case, de-energization of the circuit is desirable for optimum safety even with covered electrodes.

Where two or more welders are working on the same structure and one is likely to touch simultaneously the exposed parts of more than one electrode holder, the welding machines must be connected to minimize shock hazard. Peferably, all DC welding machines should be connected with the same polarity. A test lamp or voltmeter can be used to determine whether the polarities are matched. It is preferable to connect all single-phase AC welding machines to the same phase of the supply circuit with the same instantaneous polarity.

Connections for portable control devices, such as push buttons to be carried by the operator, must not be connected to circuits with operating voltages above about 120V. Exposed metal parts of portable control devices operating on circuits above 50V must be grounded by a grounding conductor in the control cable. Controls using intrinsically safe voltages below 30V are recommended.

When a welder has completed the work or has occasion to leave the work station for an appreciable time, the welding machine should be turned off.

Only qualified personnel should perform equipment modifications and maintenance. Machines should be inspected frequently for accumulated dust or lint that may interfere with ventilation. Louvers and internal electrical coil ventilation ducts should be similarly inspected. It is good practice to occasionally blow out the welding machine with clean, dry compressed air a low pressure. Adequate safety precautions such as proper eye protection should be taken. Air filters in the ventilating systems of electrical components are not recommended unless provided by the manufacturer of the welding machine. The filters should be inspected as recommended by the manufacturer. Machines that have become wet should be thoroughly dried and properly retested before being used.

Equipment should be installed in a clean, dry area. When this is no possible, it should be adequately guarded from dirt and moisture. Installation must be done to the requirements of ANSI/NFPA 70, National Electric Code, and local codes. This includes necessary disconnects, fusing, and type of incoming power lines.

When not engaged in welding activities (eg. at break or lunch item); never lay an electrode holder down with an electrode/rod inserted, or a GTAW torch with tungsten sticking out passed the cup

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Welding Program Coordinator

Appendix 5B – PECO Peer Group (Welding Council) Charter

To be added later.

Section 6
WPS/PQR Issues

This section compiles survey responses concerning qualification of Welding Procedure Specifications (WPS). Items including welding process use, coupon and filler material procurement, qualified ranges, qualification methodology and laboratory testing are highlighted. Current and future needs as well as potential for utilizing jointly qualified procedures are examined.

Current Welding Process Usage

Each survey participant provided estimates, on a percentage basis, of welding process usage. It is presumed that the following summarized information relates to individual experience in their nuclear facilities.

Process	Usage, %
SMAW	18 to 85; 55 typical
GTAW	10 to 80; 40 typical
GTAW-AU	Limited to 10; 2-5 typical or provided by Contractor
GMAW	Limited to 10; < 5 typical
FCAW	2 to20; < 5 typical

A major departure from the above usage is observed at PP&L. In 1997, about 50 percent of all welding was conducted with FCAW. In 1998, they anticipate that this percentage of usage will increase to over 70 percent of their total welding activities.

PQR's - Background

The need for a qualification is primarily a function of planned activities or repairs according to eight survey participants. In addition to planned activities, emergencies and anticipated future needs were cited by the other participants as reasons for additional qualifications.

All utilities indicated that internal measures were in place to avoid redundancy or unnecessary duplication of PQR's. One party indicated that they no longer could utilize some PQR's qualified under their fossil program (audit findings) and thus would require some additional/redundant qualifications within their system. All indicated that PQR's were conducted on site.

Four survey participants qualify all PQR's (and welders) in accordance with ASME IX (PQR testing per ASME III and VIII, as appropriate) and maintain a single system in lieu of maintaining procedure and welder performance qualifications for individual codes **(Best Practice)**. Differences among various codes and their requirements are normally insignificant from a technical standpoint. Even though design criteria may vary, few if any real differences exist between welding on the reactor vessel, pressure piping or a hand rail. Other codes or different requirements (example, AWS v. ASME preheat or PWHT) are addressed in general requirement type implementation procedures. From a practical view, if a welder can demonstrate ability to weld on piping or plate in accordance with ASME IX, he/she should certainly be able to weld on structural steel. Single tier systems also significantly reduces documentation, PQR and welder qualification redundancies and potential audit problems.

PQR Coupon Selection, Test Requirements & Procurement

Base metal coupons for procedure qualification are chosen for a variety of reasons including a specific application, maximum flexibility and range of use, availability of material or economy. Survey participants offered the following as their basis for coupon selection:

Basis	# Participants
Application	5
T=3/8" & 1-1/2"	6
Most Bang for Buck($)	2
Over 8"	0

No one indicated that they had any procedures qualified to address heavy-wall vessel-type thickness over eight-inches. Although a remote possibility, if a need for repair of such heavy wall material was determined, separate qualification would be required. Only the OEM's typically conducted such qualifications. Conversely, notch toughness criteria are imposed in and around the nuclear island, but the extent is directly dependent upon the specific code and year/addenda. For example, piping outside the nuclear island installed in accordance with ANSI B31.1 will not have toughness criteria whereas similar piping in another facility that was installed to ASME III may have. Where needed, respondents order coupons with appropriate mechanical properties, including toughness and in some cases special heat treatments.

Significant variation in responses occurred with respect to procurement as "Safety Related" materials between the coupons and weld filler metal. Responses are itemized below:

Method	Coupon	Filler
Procure as Safety Related	13-no	3-yes, 10 no
SR Not Req'd, but usually	3	3
Only Spec. grade & overcheck	4	4

Most plants required CMTR's for both coupons and filler metal. Three utilities require CMTR's on filler metal only. The remaining participants obtain CMTR's on coupons and filler metal as available.

The survey indicated supply of coupons as follows:

Supplier	# Participants
Low Bidder or onsite stock	8
Approved Vendor List w/CofC	2
Triangle Engineering	3 (5 for pipe or exotic mat'ls)

PQR Instructions & Welding

In at least ten cases, a preliminary WPS or instructions are generated to provide general guidance to the welder and associated personnel for qualification of a procedure. The Welding Engineer prepares instructions at nine facilities. Only two plants do not prepare any written instructions.

Personnel participating in PQR activities, as a program requirement versus a courtesy, include (number of utilities shown):

Personnel	Required.	Courtesy
WE/WPO	10	1
WS	2	1
QC	4	3
ANII	2	4

Physical data and parameters are recorded by the Welding Engineer, Welding Program Owner or Corporate Welding Engineer at ten plants. The Welding Supervisor, ISI Engineer or Welder performed this task in three facilities.

Eleven facilities require use of calibrated voltmeters and ammeters during a PQR test. Only two utilities mandate use of calibrated stop watches (**Less than Desirable Practice**). Requiring calibrated stop watches seems overly restrictive given normal variation in reaction time among different personnel. A personal wrist watch provides a level of accuracy satisfactory for PQR activities.

Only one utility indicated that they do not provide some form of special training, preliminary WPS/PQR or instructions to welders prior to performing a procedure qualification weldment. And, all but one facility provides these instructions on an informal manner.

PQR Testing

Ten utilities stated that testing laboratories were selected from their approved vendor-type list. Four participants indicated that they relied on their internal corporate laboratories. Private laboratories that were used included: Altran, Applied Technical Services, Babcock & Wilcox, Bodulate-Taussig, General Electric, Herron Testing Laboratories, Hurst Metallurgical Laboratories, Laboratory Testing, Inc., Law Engineering, Lehigh Testing , Metallurgical Engineering and Testing (Phoenix) and

Lucius Pitkin (NYC), PSI-Pittsburgh Testing, PTO, Sherry Labs, Southwest Research Institute, Taylor-Forge, Payola, KS ,and Triangle Engineering (conditionally approved).

PQR Status and Anticipated Needs

Survey responses provided information about welding procedures, either now qualified or those that are needed, that are quite different from those qualified during original construction and traditional repair. Originally, a limited number of welding procedures to address low carbon steel and 300-series austenitic stainless steel were all that were developed. Now however, repair and refurbishment of plant equipment, even sophisticated repair, is a necessity and not a luxury.

Examples of this trend for addressing hardfacing and/or erosion/corrosion issues are illustrated below:

PQR	# Participants
Stellite® (6 or 21)	9
308/309 Clad Overlay	4
410	2
NOREM®	1
Nickel Base	2

Only two participants did not believe they had any planned or future PQR needs. Other users anticipated PQR needs in the following areas:

GTAW Aluminum
Underwater SMAW (P1, P8 to P8) and FCAW (P1 to P8)
P1 to P8 w/impacts
P4 to P4
GTAW thin Stellite®
NOREM®
Temperbead (P1, P3)
416 to 304
GMAW-P
Shrunk-on turbine discs
Copper Nickel (90/10)
FCAW (P11 to P1, P11 to P11)
Aluminum Bronze

Five participants indicated that PQR needs could probably be satisfied on a joint qualification basis (**Best Practice**) for areas including underwater welding, NOREM®, GMAW-P, shrunk-on disc repairs and temperbead applications. Seven participants had no interest in a joint PQR qualification, primarily due to internal program changes that would be difficult or near impossible to implement on a reasonable basis. Licensing and relief request (USNRC) considerations were also cited as reasons for avoiding joint qualifications.

The shared PQR data and database assembled by EPRI RRAC is planned to be used in various forms by eleven of the survey participants. Most responses indicated that this is a resource that will allow their utility to save both time and money **(Best Practice).** However, PECO and SONOPCO indicated that they would use the information for guidance only and probably qualify their own procedures. Others (10) indicated that they would use the information to the maximum extent possible, pending USNRC acceptance of Code Case N-573. To date, only NYPA has submitted a formal request to use the Code Case. However, PECO and GPU Nuclear are in the process of a licensing review to generate a relief request.

Section 7
WPS Assignment and Field Issues

This section summarizes survey participant responses concerning WPS development, assignment to work, implementation and revision. Field issues including methods of weld groove preparation, special equipment, inventory and maintenance are also addressed.

WPS Development

All survey participants prepare WPS's from a broad perspective such that many situations can be addressed with a single document. Reasons cited for this approach include minimizing chances for mistakes, versatility and getting the most "bang for the buck". NYPA stated that they have focused their efforts toward training and qualification of welders on a successful basis rather than on tightly written WPS's (**Best Practice**).

The approval cycle for WPS's differed widely among respondents, however, none indicated that review was required by a Safety Review-type Committee. One program requires two qualified technical plus two qualified safety review type personnel while three other individual programs only required approval from an Engineer, Welding Engineer or Chief Metallurgical Engineer. Others required involvement from the following personnel:

- Welding Engineer+Techncial Review+Engineering Supervisor+QC+ANII
- Welding Engineer+QA
- 2 to 3 Corporate Welding Engineers
- WE+QC+QA+Engineering+ANII
- Corporate Welding Engineer+Maintenance Supervisor+Engineering Project Supervisor
- 2 Welding Engineers+Design Group Supervisor

Approval cycles that involve numerous individuals may tend to discourage development or revision of WPS's, even when needed. A streamlined process that relies upon two to three technically knowledgeable personnel, such as Welding Engineers, to make an acceptability determination is more favorable and far less time consuming (**Best Practice**).

WPS Assignment

The majority of those responding to the survey stipulated that their Planner assigns WPS's to specific welds. Heavy reliance is placed on the use of line tables and original design/equipment specifications for determination of materials and what WPS would be appropriate. Only six plants indicate that Planners use matrices to assist in the assignment process. (**Best Practice)**

Weld maps are also used by all participants to assist in the planning process as well as to conduct the work. Four plants require engineering approval for any changes which initiate revision of the work package and/or later revision of as-built drawings. Nine plants permit these maps to be changed without engineering approval, but changes must be noted in the work package and as-built drawings reconciled at completion of the job. The latter practice reduces delays and permits work to continue.

Eleven programs utilize legend-type designations for both unique identification as well as some indication of what the WPS involves. For example: CS-1/1-A (i.e., carbon steel, P-No. 1 to P-No. 1, etc.)

Nine utilities specify multiple filler metals on single WPS's, as appropriate. Four plants indicate that they do not permit this practice and that options for using different WPS's, when needed, are provided in the work order or package. Limiting WPS's to only a single filler metal results in the need for far more documents, increased document control and a reduction in flexibility during the planning process.

Only two plants require a "Change to Engineering" document to revise a WPS assignment, and then only if a design change is involved. Otherwise, the survey participants revise assignments via their planner in the work package. This approach enables work to continue without lengthy revise/review cycle delays.

WPS Revision

Four utilities permit field revision of WPS's by their Welding Engineer, and then only for changes to non-essential variables (**Best Practice**). Any such changes are recorded in the work package or traveler. Typical revisions follow a normal approval cycle.

WPS - Implementation

Six programs include WPS's in their work packages. If revised, procedure revisions are verified and documents are changed prior to commencement of work. Some verify changes or proper revision at rod issue, others via the foreman. Major problems were not identified with this approach. NYPA and PP&L do not include WPS's in the work package, only a reference to appropriate WPS's. In fact, only four programs require specific reference to WPS's while nine programs use general references.

Revision of WPS's in the work package is not an issue at Wolf Creek because they do not delete earlier revisions, all remain active. Their justification relies on the logic that if a revision was acceptable when the work or package was planned, then there would be little if anything that future revision would invalidate. (**Best Practice**)

Eleven programs require WPS's to be with the welders, at the work site or in the package. Niagara Mohawk and PP&L only require WPS's to be in the work package. NYPA has no requirement, but the WPS is usually in the work package.

Field Issues

All survey participants indicated that they owned and utilized portable field machining equipment for preparation of weld grooves. In addition, in house competence with the equipment was noted by each plant.

Six facilities utilize a hydraulic iron worker to aid fabrication of structural items. Other plants did not have such equipment, but APS noted that they enjoyed a fully equipped machine shop with shear.

Plasma cutting equipment was available at five plants, while the remaining facilities indicated that they had no specialty flame or plasma cutting equipment.

Updated welding equipment inventories were maintained by eight of those surveyed. Seven plants indicated that they share equipment with other facilities, but that is was often difficult to get items returned at all or in the condition it left their plant.

Performance of periodic maintenance on welding equipment is typically instituted on an as-needed or pre-outage basis only. PECO indicated that on a one to three month basis, they wait until a number of machines become inoperable, then call in an appropriate vendor to repair them. Only TVA stated that they perform preventative maintenance on an annual basis.

Section 8
Welder Qualification Issues

This section of the survey is comprised of a total of 52 questions which concentrate on welder performance and qualification. The first 17 questions focus more on the philosophy of testing and qualification, while the remainder of the questions concentrate more on actual testing. The following discussion will focus on those key areas.

Testing Philosophy

The responsibility of testing welders in a majority of cases falls upon the Welding Engineer (8 of 14 responses); however, the Welding Supervisor or the Welding Coordinator may also be assigned this responsibility. Welding craft (labor) is commonly drawn from the union halls (8 responses). The remainder of the responders indicated that either internal craft or on-site contractor craft were utilized. When craft is brought on site for testing, welders are expected to qualify without preliminary training. Training is occasionally administered to internal personnel prior to testing however.

ANII and QA/QC involvement in the actual welder performance is not required by roughly one half of the utilities who responded to the survey while seven indicated that informally they are notified. Two utilities suggested that QA/QC was always involved in the process. The functions and responsibilities of the ANII ranged from none (7) to random (2) to surveillance (4). The response regarding QA/QC functions and responsibilities included none (4), while others indicated visual and RT signoff, surveillance and review, or checkoff.

Welder Testing

Several additional questions were asked to gain some perspective of how welder testing is broadly implemented. The following table provides the results in a yes/no format:

Question	Yes	No
Mandatory signoffs	3	8
Test log maintained	9	4
Welder ID stamps given prior to completion	8	3
Welder given written instructions	11	2
Positive identification made of welder	9	4
Practice allowed prior to testing	9	4
Time limits imposed on testing	6	7
Coupons identified[1]	10	2
Purchase or preparation of coupons controlled	10	3

[1] Coupons are typically marked with a social security number or welder identification number.

Welder testing is commonly performed on-site in a test shop (includes during outage). Of the 14 WPO responses, only two utilities (Alliant-IES Utilities and GPU Nuclear) utilize the union hall for testing. The number of welders tested at any one given time averaged between 12 and 13 welders with a range of 5 to 20 per shift. Administered tests typically included:

- 2-inch XXS open butt carbon steel GTA/SMA weld
- 2-inch XXS open butt stainless steel GTA/SMA weld
- other (see below)

Other tests ranged from 6-inch XXS carbon steel GTA/SMA weld with a backing ring to a 6-inch XXS stainless steel GTA/SMA weld with an insert to GTA Inconel welds. No specific pattern was apparent for the “other” qualification, only for the first two tests administered. Multiple process (GTAW/SMAW) testing was performed by all responders except one.

In general, hold points were assigned for inspection at four specific times during the welding process: fit-up (tack), root pass, hot pass, and final (or cap). Weld tack size and intervals (or number) are controlled at seven utilities, while the remainder indicated that tacks are informally checked. Typical intervals are 3 to 4 inches (maximum) with the size designated at 3/8- to ½-inch maximum. Tacking position requirements are not invoked by most utilities. An interesting sidebar—only two utilities utilized fit-up tools. This may be indicative of the size of the test coupons used in testing, not actually a field practice.

Five utilities responded that data is collected and recorded for all root welding qualifications. *No attempt was made to follow-up with these five to see how the data was utilized.* At least one utility records the statistical results from the qualifications and publishes them following review. This provides the Welding Engineer with data on who the “real performers” are as well as provides the welder with some feedback on his performance. The process of collecting data on root qualifications and providing feedback on performance is considered a **Best Practice**.

In contrast to recording root welding rejection rates, all but three utilities archive welder qualification test data using some form of database software. Such data can be used to identify welders with previous poor performance, and thus reduce testing time and expense of retesting these individuals. The software was typically developed internally and is linked to a mainframe for permanent archive. Most utilities felt the software could be improved and that it should have the capability of “process updating.” Only two utilities (NYPA and CEI) responded that process update capability was included in their internal software. One actually linked weld rod requisitions through the software (**Best Practice**).

Welding travelers were not considered a necessity for most utilities during testing. Only three indicated that travelers were employed for welder testing.

Supervision of qualification testing is typically performed with the supervisor physically located in the test shop or same general area. Most utilities suggested supervision was constant throughout the welding process and that final inspections are performed by the Welding Engineer, Welding Coordinator/Supervisor, or in at least one case by QA/QC. Radiography is employed by 5 utilities whereas 8 utilities use Section IX bend tests. The primary reason sighted for the radiography preference was RT is more cost effective. A few utilities indicated that they plan to move toward radiography. Radiography, when used, is performed on-site. When radiography is utilized, most utilities responded that weld caps are ground flush. The final weld cap height is commonly limited to no greater than 1/8-inch and one responder indicated that QW-194 requirements for cap height are invoked.

Those indicating that bend tests were employed sighted similar reasons for its use: bend tests are cheaper and testing equipment is inexpensive and readily available. Bend samples are normally prepared in accordance with Section IX criteria and are fabricated and tested using equipment (cutters, benders) made by Triangle Engineering. Bend specimens are discarded after recording to protect liability and most are marred physically to minimize the potential of reuse (cheating). (**Best Practice)**

Section 9
Purging

Background

The purpose of this section of the survey is to examine the various approaches to purging and to determine if utilities are utilizing structured procedures for purging. Many utilities experienced problems with purging during repair/replacement of recirculation water piping systems and nozzle-to-safe ends during the 1980s. Problems during that period emanated from: 1) purchase of bad gases which exhibited inferior dewpoints or contamination, 2) excessive oxygen levels in bottled gas, 3) unfamiliarity with the low dewpoints often associated with bulk gas systems, and 4) inferior purge dam materials/methods. Hence, Section 9 was structured to concentrate on these problems to identify if similar difficulties persist today or if they have been rectified. Also, those conducting the survey attempted to identify best practices for purging applications.

Proceduralization

The results of the survey suggest that the industry (both utilities and gas suppliers) has apparently learned from its earlier problems associated with purging. This is evidenced by the proceduralization of some of its practices and by the minor number of instances that were reported where purging had resulted in welding problems. An example of proceduralization of practices is shown in Appendix 9A. The example procedure was developed by WCNOC and is targeted at "Control of Dissolvable Purge Dam Material." It defines requirements for procurement, handling, and issue of soluble purge materials. Similarly, it should be pointed out that DAEC, WNCNOC, and SONOPCO also have individual procedures for dissolvable purge dams.(**Best Practice)**

Welding Gas Purity

All survey responders indicated that individual cylinders are commonly employed thus lowering the volume of gas required and reducing the potential of aspirating air into large bulk systems through leaks in fittings, gas lines, etc. Liquid gases which tend to offer improved dewpoints and gas quality are also employed by approximately one-half of the responders. Low volume purge methodologies were used by 2/3 of the group. It is unclear whether the low volume purge methods were aimed at cost savings (a reduction in the amount of purge gas and time required) or aimed at improvement in purge quality (or both). Approximately one-half of all utilities have gone as far as to require QA/QC hold points for purging.

In terms of purge quality, a majority of the group (11 to 1) indicated that oxygen meters were employed to monitor the purge gas prior to welding as opposed to dewpoint meters. Two utilities have specified dewpoint in their gas procurement specification to assure satisfactory gas is obtained. When asked about bad gas experience with gas vendors, as many as five responders said yes while the remaining 8 indicated no problems. The location at which purge gas is monitored was normally at the top of the weld joint or at a vent port.

Associated Areas

Another question of the survey sought to obtain information on purging requirements for P5A (2-1/4Cr-1Mo) materials. At least two utilities employ purging for such weld joints, while the remainder indicated no preferential use of purging for this application. No report of problems arising from the lack of purge practices was determined.

An additional area that was explored in a somewhat similar context was the use of alternative or supplemental purging media (e.g., solarflux). Ten utilities indicated no experience with such alternatives, while one indicated such media had been qualified and used successfully. Three utilities are (or have) explored the use of self shielded electrodes for root weld applications. At least one utility had qualified procedures for use in non-nuclear applications.

Appendix 9A -- Control of Dissolvable Purge Dam Material

Section 10
Postweld Heat Treatment

This section, like the section on Purging, was developed to examine the various approaches to postweld heat treatment and to determine if structured procedures for PWHT are being utilized. Additionally, this section focuses on determining what forms of equipment are being utilized for temperature acquisition and recording and on who was responsible for performing site PWHTs.

Procedures and Equipment

Of the 14 utilities who responded to the survey, twelve answered that PWHT procedures had been formalized and are currently in use. Most utilities (13) owned their own PWHT equipment and approximately 75 percent indicated that someone within the organization was competent in the use of the equipment. Because most utilities already have formalized procedures, no attempt was made to include an example procedure in this section.

WPOs were asked to identify what guidance is typically used for the following major categories:

- Equipment calibration
- Thermocouple placement
- Pyrometer or temperature crayon use

Most responders stated that guidance for equipment calibration was spelled out in the PWHT procedures. Pyrometers or temperature indicating crayons were used or procedurally permitted by only two of the fourteen responders. Their use was limited to preheating applications or on an emergency basis only.

Several survey questions were targeted at "application" of PWHT technology. The first question focused on the recording equipment. Over 90 percent of the responders indicated they employ traditional strip chart recorders to monitor PWHT activities, as opposed to computer monitoring equipment. Computer monitoring equipment, when used, was placed in parallel with strip chart recorders. The reason that most utilities still employ strip chart recorders is that they are reliable and plant personnel have good experience with the equipment. Some consideration should be given to using computer monitoring, due to its ability to permanently archive PWHT data and supply graphics for reporting. Computer monitoring also eliminates the large strips of recording paper associated with strip chart recorders. Reasonably inexpensive MS Windows-based sources of temperature acquisition systems include: Strawberry Tree and LabView.

PWHT Expertise/Contractors

Nine utilities reported using PWHT/specialty welding contractors such as: Cooperheat, Mannings, Global Heat, Reliant, Western Stress, PCI Energy, or Welding Services Inc. to supplement in-house capabilities and expertise. Many utilities utilize contractor craft, while three utilities reported the use of PWHT contractor supervisory staff. The use of outside personnel or supervision is normally mandated by engineering. The WPO has little input regarding the decision to use contractor staff.

P-4/P-5 PWHT Exemptions

The final question under the PWHT section targeted the issue on PWHT exemptions. Utilities were asked if a relief request had been forwarded to the NRC take exception to PWHT of P4/P5 pipe welds over 4” NPS (based on the results RRAC report on TR-108129 *Review of Postweld Heat Treatment Requirements for P-4 and P-5A CrMo Materials*). Three utilities responded positively. These requests, in tandem with the recent RRAC report, along with ASME B31.1 review in this area, spurred the recent changes in ASME B31.1. As of October 1998, the B31.1 now accepts repairs on P4 and P5 materials for all diameters provided the thickness does not exceed ½-inch, the chromium content is 3 percent or less and the carbon content is 0.15 percent or less.

Section 11
Non-Traditional Practices

The commercial nuclear power industry is known for it's strict regulation and compliance necessary to provide a high level of safety to the general public. There is also tremendous pressure to remain financially competitive, in spite of this regulation. As a result, plant operators and maintenance personnel are constantly challenged with improving the plant operating efficiency. This is best accomplished by keeping the plant on-line.

This section provides a short description of innovative, yet sometimes simple repair practices that have been used to keep a plant on-line or to resolve nagging maintenance issues. These innovative solutions range from temporary repair techniques, to design changes which improve performance or endurance, to methods for training of personnel. The key characteristic of each is that someone stepped "out of the box" and tried something that had a high level of reward without jeopardizing the public safety.

Temporary Repair Techniques

Leaking pipes, valves, couplings, and flanged connections constantly present a repair challenge which threatens to bring a unit down. Listed below are some practices which have been successfully used to stop leaks. In many cases an engineering change review was necessary to implement temporary changes.

◊ 24" RWCU Heat Exchanger, leak of o-ring basket. Put a split and bored end cap (bored hole for pipe to go through). Put fillet weld around flange and pipe and a full penetration groove weld on split. (SONOPCO)

◊ Tapered pins (darts) put into pinhole and seal welded to stop leak. (NYPA)

◊ Pin hole in a copper line. A 1/8 diameter silver solder rod was sharpened and placed in hole. The pin was then heated with an oxyacetylene torch to melt the pin. (PECO)

◊ A weld-o-let or threaded coupling was welded over a pit, which had caused localized wall thinning of a service water system pipe. To meet the requirements of USNRC GL 90-05, a hole was then drilled into the pipe and the weld-o-let plugged, thus treating it as a branch connection. (PP&L, NYPA, PG&E)

◊ Covering the leaking area with another piece of pipe and applying a fillet weld around the perimeter of the patch repaired a steam leak in a B31.1 pipe due to a pinhole. The patch in effect became a secondary pressure boundary. (PECO)

◊ Temporary encapsulation chambers such as split pipe (designed as pressure vessel) were applied over thinned piping as a secondary pressure vessel. The chambers were fillet welded at the ends around the pipe diameters and a full penetration groove weld placed along the split line. (TVA, WCNOC, DAEC).

◊ Hole was found in bottom of a non-safety related globe valve body due to impingement. System could only be isolated for a short period of time. A hole was drilled and tapped in the bottom of the valve and a treaded plug made of a more erosion resistant material installed. The threads were coated with a Belzona Molecular Metal prior to installation. No welding was performed.

- ◊ Leaking of a service water system line due to pitting and erosion was temporarily repaired using red rubber and hose clamps. This was crude and simple but quite effective. (PP&L)
- ◊ Weld overlays were performed on the inside (flow side) of elbows, pump casings, and valve bodies with stainless steel filler material for erosion/corrosion resistance. (PP&L, NYPA)
- ◊ During hot functional tests a small leak was discovered in a stainless steel line. The leak was peened to stop the leaking and an Inconel 182-stick electrode was used to seal the flaw. (APS)
- ◊ Paper gaskets made from rice paper purge dam material were used in socket welds to hold back water and moisture during root pass welding. (PG&E)

Alternative Repair Practices

- ◊ Welding procedures were qualified with an ER-308L flux-cored GTAW electrode for BOP applications. This new electrode generates its' own shielding gas eliminating the need for a argon back purge when performing root pass welding of full penetration weldments on stainless steel substrates. (TVA, GPU)
- ◊ The use of balloons and sailcloth bladders, and other low volume purge techniques are used extensively at PG&E for piping repairs and replacements. Several of these techniques are described in EPRI Report TR108143.
- ◊ FCAW procedures were qualified and used for MSR replacement. These procedures included P1 to P1 and P1 to P11. (NMPC)

Design Modifications

- ◊ A 2:1 fillet leg length has been used to increase fatigue life of socket weld joints. This practice was initiated at Perry Nuclear Station during construction and has remained a standard practice.
- ◊ Carbon steel pipe with roll bonded stainless cladding was installed in a BOP application for erosion corrosion resistance. The pipe was joined utilizing a stainless steel backing ring, a Type 309 filler material, and the FCAW process. (PP&L)
- ◊ First Energy has experienced problems with leakage of the RHR isolation valve from the main steam system. This valve is no longer used and has been red tagged in the closed position. If this valve leaks by during operation it will cause heat up and pressurization in a downstream heat exchanger. This indeed happened requiring a quick innovative solution. A 19" length of the 10" diameter pipe was removed from the RHR piping and replaced with a carbon steel SA-234 GR-WPB blind pipefitting designed by First Energy. The new spool piece had matched the pipe ID and OD with the appropriate weld preps on both ends. The unique feature was that the spool piece was not machined all the way through thus creating an integral blind (Figure 11-1). Because the completed pipeline and weight was not changed, all hangers were able to remain as before and no new seismic calculation was required.

- ◊ A blind flange on the reactor head had been a problem leaker on several occasions. Since the flange was never used, the blind flange was removed, a disc was welded inside the bore just below the flange face surface with a partial penetration groove weld, and the blind flange bolted back on. The bolted blind flange was maintained as the pressure boundary thus eliminating future inspection requirements.

Administrative Practices

- ◊ A section on welding with steam and water present has been added to plant welding manual at PG&E. This section describes the guidelines in which temporary or permanent weld repairs can be made in wet environments.

Figure 11-1

Figure 11-1

Section 12
Summary of Best Practices

Peer Group

The most valuable Best Practice is reflected in this group meeting today. Peer groups, the open sharing of ideas, concerns, challenges, and responses. PECO, NYPA, and TVA serve as models within our group and their Welding Councils are ideal examples. Regular (monthly) meetings supported by upper management assure that information is shared and projects are pushed along, not forgotten. For smaller utilities the concept of peer groups can include plant personnel plus invited guests from surrounding utilities industry. The idea is to focus attention on specific subjects. Agendas for such meetings should include:

- Past problems
- Current or potential problems
- Procedural quality and adherence
- New equipment and processes
- Qualification at all levels within the welding program
- Cost awareness
- Educational or technical presentations

Filler Metal Procurement

Eight utilities procure weld filler metals as safety related material only. The five remaining prefer to procure as Safety related unless the material is not available. The practice of procurement on a Safety Related basis, when possible, is not new for all but one utility, and they switched to this practice about five years ago.

A more flexible approach to filler metal may be required as repair needs evolve to address emerging issues. Some consumables needed to address special needs may be only produced by manufacturers who produce a satisfactory product, but do not operate of offer materials under a sophisticated10CFR50 Appendix B program (eg. NOREM)

Weld Rod Storage

A wide range of how covered electrodes are stored and issued was found. One plant does not store E308/309 in heated ovens. The other plants do. A majority of plants allow 4 hour “out” times for E7018 but mandate that warmers be used from issue till return. A minority do not use warmers and the “out time” is 10 hours. This subject should be reviewed by our group and RRAC to determine the best practice.

Filler Metal Control

WCNOC has taken the most rigid approach to filler metal control. This statement is based on several factors. First, upon entry into the tool room you see signs posted indicating “Authorized Personnel Only”, “Level B Storage,” and “Quiet Zone.” Thus, you immediately recognize that WCNOC and its management takes filler metal control and distribution very seriously. The room is extremely clean and well organized with permanent labels on every item. One issue point is employed and the individuals in charge of the room are well trained specifically for that task. No superfluous discussion of non-work related activities is allowed, therefore, the room attendant is able to focus his full attention upon the task at hand and human errors are thereby minimized. The “quiet zone” sign means just that--non-work related discussions are not appropriate.

During an outage, eight units indicated that they implement additional issue points on the refueling floor for underwater welding or for major activities in isolated locations such as a BWR torus modification. Five plants indicated that they do not increase the number of stations, but with one exception, these units maintain issue points both inside and outside the RCA. At CEI, delays and confusion are further reduced during busy times by issuing welding consumables to welders on critical path jobs on a priority basis.

At PP&L, a main issue facility outside the protected area feeds satellite issue stations inside the plant in the main tool room/issue point as well as one in the hot machine shop. Thus they have the advantage of issue points both inside and outside of the RCA. This approach reduces issue/return lost time within given shifts and provides an opportunity to reduce radwaste because "warm" welding electrodes could be reissued.

--Bar Code & Credit Card imprints

To further amplify on control of filler materials, PP&L uses the following: 1) all materials must go through tool/filler metal control room, 2) credit card imprints are utilized on all rod slips which identify heat number, etc., 3) rod slips are zeroed out, and 4) stub barrels are locked.

TVA uses bar coding for filler metal control. Upon receipt of filler metal by the warehouse, a bar code is assigned to the heat or lot of material. The bar code is used in a computer database to track filler materials by welder ID, work package, and through the weld material requisition program.

--Weld Material Requisition (WMR)

More than one WPS was permitted to be listed on a WMR by seven facilities. The ability to implement this flexibility is a Best Practice. Avoiding mix-up of fillers is stated as the major reason for not allowing this practice by the remaining plants. Since most of those surveyed permit multiple WPSs to be listed on the WMR, perhaps concerns over problems are unfounded.

--Disposal

A number of utilities used locked and pilfer proof barrels which provides a barrier and precludes the use of unauthorized filler materials. A few utilities took filler metal control one step further and made final disposal of weld rods a non-issue in that a dumpster was located outside of the fence. This further strengthened the barrier to use of unauthorized filler materials.

TVA actually welds the barrels up once filled and has them hauled off-site.

--Vacuum Packaging for Electrodes

Only TVA indicated that they use covered electrodes in vacuum packs. Use of such packaging (1 to 4 lbs. per package) can mitigate the need for holding ovens, provide go/no-go information on moisture control (if package is not broken, integrity is maintained), and provide a means for easy frisking, decon and removal of unused material (package unopened) from the RCA. Vacuum packs are available as standard packaging from Electrode Engineering, Metrode and Lincoln Smitweld. Others offer such packages on a special order basis.

-- Filler Rod Ovens

A variety of approaches were encountered related to filler rod oven monitoring. A few utilities employed strip chart recorders to monitor ovens, others use digital meter readouts and alarms (if power is interrupted), and others used data loggers to monitor up to 20 ovens at one central point.

Because of the forgiving nature of today's covered electrode formulations, availability of low moisture coatings and alternate packaging not requiring ovens (vacuum packs), it appears that avoiding the use of portable ovens warrants serious review.

-- Spooled Wires

Nine utilities listed the use of spooled wire (GMAW or FCAW)and controlled them quite differently. Note that PP&L plans to use FCAW for over 70 percent of all their welding during 1998. Four users leave the spools on the wire feeders in locked enclosures and sign over control slips to the next shift (PP&L and TVA use this method successfully).

DEAC uses a keyed interlock on GMAW equipment and allows spooled wire to remain on the machine. The key is the primary control feature and must be returned at the end of each shift or job in lieu of the spool.

Software

NYPA has been using in-house software for 12 years for tracking filler metal and welder qualifications. This software is available to anyone who wants to review or use it. The program provides reverse traceability by heat number, purchase order, Welder ID, and Work Request number. The same system is used to track welder qualifications, WPSs, and generate welder performance qualification reports.

PECO is in the process of developing and refining the weld information system. This modified MS Access application which is being used to document and track filed welding.

WCNOC uses a "MAPPER" database to control the welder qualification processing as well as the filler metal inputs used to update the process qualifications. WCNOC is looking to update the program as Information Services no longer supports the software.

TVA utilizes an in-house developed database for capturing and updating welder qualification by linking the welder test qualification data and the weld metal requisition data, to continually update personnel welder qualifications. This system works well, the WPO is happy with it, and is continually looking for ways to improve upon it. Like several of the systems described above, it provides reverse traceability.

PG&E utilizes a software database which was developed internally to track welder qualifications. The system has been in place for approximately 12 years. Its capabilities include tracking by Welder ID, work order number, and filler metal "trace" number. It represents the basis for process use and updating. One of the interesting features of PG&E's database is that the WQ has been through site QA. (Additional discussion will be added on PG&E software for the final document)**.**

Trending

PP&L issues a monthly *Trending Program/Report* to look at acceptable welds versus defects. Currently the rejectable rate has been reduced to 1 rejectable defect/1000 inches of weld from 1 rejectable defect/11 inches of weld (based on 70,600 inches of weld). The report not only assists the Welding Engineer in tracking acceptance and required improvements, but also provides feedback to the welder on his performance.

CEI and PP&L use trending during hiring of qualified welders from outside contractors.

Weld Maps/Matrices

WCNOC uses Autosketch for weld map generation coupled with MS Word templates that are used to produce Weld Data Sheets and PWHT records. The format used for these forms incorporates several macro's to assist planners.

DAEC uses a weld developed matrix table to assign WPS and NDE criteria. The WPS matrix is an iteration of the plant piping designation tables.

The majority of those responding to the survey stipulated that their Planner assigns WPS's to specific welds. Heavy reliance is placed on the use of line tables and original design/equipment specifications for determination of materials and what WPS would be appropriate. Only six plants indicated that Planners use matrices to assist in the assignment process.

Simultaneous Welder Qualifications

GPU and PECO are pursuing sharing of simultaneous welder qualifications including multiple process updating of information.

Union Common Qualifications

NYPA is actively pursuing common qualifications through the union. Twelve Saturdays per year, the union holds tests under their qualification program. These tests are funded by the local and supervised by NYPA. The tests given are identical to those given by NYPA. Using the guidance found in Section IX, NYPA adopts these supervised tests into the NYPA system to support welding onsite. These tests are give often enough that process currency is maintained in most cases.

ASME Code Involvement

GPU, SONOPCO, APS, PG&E, and TVA actively participate in ASME Code activities which provides them with an excellent industry perspective and can impact present and future utility challenges.

GMAW/FCAW applications

PP&L is leading the way to increase the use of wire feed processes such as pulsed GMAW and FCAW. In the year 1997, PP&L estimated that 50% of their welding was performed using these wire feed processes. In 1998, it is expected that this will swell to 70%. PP&L’s tracking system allows these numbers to be collected. Using the 50% figure and accepting that these processes are at least 3 times more productive than SMAW, a net increase in productivity is evident. These savings are related to the time spent on the joint.

Similar to PP&L, PG&E is making increased use of the GMAW and FCAW processes. PG&E indicated they have qualified procedures for P1, P8, and P1-to-P8 materials.

Training

DAEC does something that appeared to be unique and is considered a best practice. Four plant welders are given 18 months of training at the local community college. This training elevates their capabilities to such a degree that they can be considered Welding Foreman or Supervisor. The plant upgrades these welders to welding foreman status during outages and they supervise the contract craft welders. This concept should be considered by all of us that are facing staff reductions and justification of outage staff augmentation.

WCNOC uses mockups to train welders on thin wall SS for welding without purge and without sugaring. The thinnest wall now allowed is 0.088-inch.

All respondents expressed that better training to the players in the site welding programs is the key element to the program's success.

At TVA, to be a Welding Foreman, you must complete 2 days of comprehensive classroom training given by the Welding Engineer and have been a journeyman craftsman

APS has a unique training program which is geared toward the QC Inspector. The program boasts successful random QC and has allowed APS to reduce the QC staff over the past two years (more will be included on this topic at a later date).

APS also utilizes a training manual for planners.

Newsletters

Newsletters, reminder cards, and responsibility placards are all manners that we can express our expectations to all participants. WCNOC uses "Stuff to think about" cards which are placed with each weld package to reinforce management's expectations.

PECO and NYPA have newsletters. GPU exercises safety alert bulletins.

Communication Technologies

While no single plant exhibited a Best Practice in this category, communication technologies warranted attention. All members are aware of its importance and striving to keep up. The use of communication technology is playing an increasing role in our jobs. The computer is essential, laptops, digital cameras, and email are tools we all need to master.

Standardization

PECO is currently developing applications using MS Access software that can be used for weld data documentation.

TVA has developed bar coding applications that are used to control and track filler materials.

NYPA is actively pursuing taking advantage of the union common qualification program.

Qual Cards - this has been an issue that several utilities are addressing. Suggested qualifications for the following positions are being explored at several sites: Welding Engineer, Welding Supervisor, Welding Foreman, Welder, and Mechanical Planner.

PQRs

APS, CEI, PG&E and SONOPCO qualify all PQR's (and welders) in accordance with ASME IX (PQR testing per ASME III and VIII, as appropriate) and maintain a single system in lieu of maintaining procedure and welder performance qualifications for individual codes.

Five participants indicated that PQR needs could probably be satisfied on a joint qualification basis for areas including underwater welding, NOREM®, GMAW-P, shrunk-on disc repairs and temperbead applications.

The shared PQR data and database assembled by EPRI RRAC is planned to be used in various forms by eleven of the survey participants. Most responses indicated that this is a resource that will allow their utility to save both time and money.

WPS Assignment and Implementation

All survey participants prepare WPS's from a broad perspective such that many situations can be addressed with a single document. Reasons cited for this approach include minimizing chances for mistakes, versatility and getting the most "bang for the buck". NYPA stated that they have focused their efforts toward training and qualification of welders on a successful basis rather than on tightly written WPS's.

Approval cycles that involve numerous individuals may tend to discourage development or revision of WPS's, even when needed. A streamlined process that relies upon two to three technically knowledgeable personnel, such as Welding Engineers, to make an acceptability determination is more favorable and far less time consuming.

WPS Revision and Field Use

Four utilities permit field revision of WPS's by their Welding Engineer, and then only for changes to non-essential variables. Any such changes are recorded in the work package or traveler. Typical revisions follow a normal approval cycle.

Six programs include WPS's in their work packages. If revised, procedure revisions are verified and documents are changed prior to commencement of work. Some verify changes or proper revision at rod issue, others via the foreman. Major problems were not identified with this approach. NYPA and PP&L do not include WPS's in the work package, only a reference to appropriate WPS's. In fact, only four programs require specific reference to WPS's while nine programs use general references.

Revision of WPS's in the work package is not an issue at Wolf Creek because they do not delete earlier revisions, all remain active. Their justification relies on the logic that if a revision was acceptable when the work or package was planned, then there would be little if anything that future revision would invalidate.

Welder Qualification

Physically marring of bend samples after recording or immediate disposal to minimize liability is considered a good practice.

Guiding Documents

The guiding document for welding activities at an overwhelming majority of the plants surveyed was the Site General Engineering Specification or a Site Welding Manual. In all but two cases these documents reference the FSAR or USAR as the top tier or invoking document. In most cases the FSAR/USAR simply states that welding will be controlled and performed in accordance with the requirements of ASME Section III and/or ANSI/USAS B31.1. ASME Section XI is referenced for Repair and Replacement activities on ISI components. This is a best practice because changes can be easily made to the welding program or procedures without having to amend the FSAR.

Procedural Guidance

-- Purging and PWHT

All but a few utilities indicated that detailed procedures have been developed for PWHT applications.

WCNOC, DAEC, PG&E, and SONOPCO have individual procedures for dissolvable purge dams. The procedures cover procurement, handling, and issue of soluable purge materials.

WCNOC has performed an engineering analysis to use the P4/P5A PWHT exemption based on the RRAC project. PECO is working on a similar effort.

-- Other

DAEC uses a procedure to provide guidance to procurement detailing the technical requirements for filler metals.

DAEC employs a mechanical testing procedure for drop weight to establish nil ductility vs. Charpy impact testing.

Safety

Special tungsten grinders have been purchased by a number of utilities to stop the practice of grooving standard wheels on bench grinders.

Fire watch requirements are fairly standard at all sites with one plant (WCNOC) posting separate fire watches at fuel gas bottles (in use) when they cannot be observed by the initial fire watch.

Fire retardant Anti-C’s -- A majority of plants have recently begun to utilize fire retardant Anti-C’s.

Section 13
Further Investigation Needed

Section 1--Introduction

N/A

Section 2—Welding Program Basis

No Areas for Further Investigation were identified

Section 3—Corporate Support, Staffing, Philosophy—Program Organizational Responsibilities

- RRAC should look in detail at software such as that developed by NYPA, TVA, PG&E, PP&L, WCNOC, TU, and others *to identify common methodologies* which can be incorporated by all plants:
  - traceability
  - tracking
  - archiving
  - report writing
- Staffing:
  - Examine adequate staffing requirements
  - Lack of Succession Planning
- Identify methods to increase number of skilled welders
  - Where are deficiencies exist and reason behind them
  - Work with unions or other common training programs
  - Work with EPRI Training Group
- Work with members to develop “flexible” guidelines for welding training (more discussion in Section 5)
- Irradiated materials welding issues
- Online repair issues
- Specialized training for NOREM, temperbead, hardfacing, etc.
- Examine why 55% of WPO time is spent on “other” activities

Section 4—Weld Filler Metal Control

- Bar Coding / Credit Card Imprints
- Handling of WMR's inside the RCA
- Determine State-of-the-Art for Consumable Exposure
- Eliminate Portable Rod Ovens
  - Extended Exposure Times
  - Vacuum Packs

Section 5—Training Qualification, and Communication

- Determine how to convince management to support continuing education and training to allow staff to perform multiple job functions (since industry is one deep at all positions)
  - this is a reasonably inexpensive task which can pay huge rewards if a key staff member leaves
- Extensive review of TU Electric model for training--provide recommendations to the group
- Examine structurally how PECO and TVA peer groups are established--develop "model"
- Joint/shared procedure qualifications with vendor involvement
- Determine how more ASME/AWS involvement can be achieved
- 3rd party review of Welding Programs

Section 6—WPS/PQR Issues

- Explore use of single tier system to ASME IX
  - Procedure qualifications
  - Performance qualifications
- Review PQR Database and Document where future needs PQR's may already exist
- Evaluate conducting joint qualifications at a utility or via a subcontractor for economic reasons

Section 7—WPS Assignment and Field Uses

- APS Random QC Program
-
- Updating or revising packages

    – WCNOC, CEI, etc.

- What documentation/instructions go across the SOP?

– Work Order
– WPS
– Weld Map
– Other

Section 8—Welder Qualification Issues

- How is the root welding data being used? If it isn't, why is it being recorded? Discuss with 5 utilities.

- Perform in-depth examination of TVA, SONOPCO, NYPA, PECO, and CEI to see how process updating is being accomplished via internal software.

- Discuss with NYPA to determine how weld rod requisitions are linked through software

Section 9--Purging

- No Areas for Further Investigation were identified

Section 10—Postweld Heat Treatment

- Standardization of temperatures and time @ temperature among various Codes

Section 14
Utility Contacts

Alliant-IES Utilities, Inc.
Mr. Scott Presler
Alliant-IES Utilities, Inc.
Duane Arnold Energy Center
3277 DAEC Rd
Palo, IA 52324-9785
319/851-7271
scottpresler@alliant-energy.com

Arizona Public Service Co.
Mr. Ramakant P. Indap
Consulting Metallurgical Engineer
Arizona Public Service Co.
Palo Verde Nuclear Generating Station
(M/S 7545)
PO BOX 52034
Phoenix, AZ 85072-2034
602/393-5244

FirstEnergy Corp.
Mr. Rick Rogoski
Design Engineer/PNED
FirstEnergy Corp.
10 Center Rd
Perry, OH 44081-9514
440-280-5471
rsrogoski@firstenergycorp.com

GPU Nuclear, Inc.
Mr. Richard B. Corbit
Welding Engineer
GPU Nuclear, Inc.
Training Center (M/S NOB-3, TMI)
PO BOX 480
Middletown, PA 17057-0480
717/948-8658
rcorbit@gpu.com

New York Power Authority
Mr. Neal A. Chapman
Welding Engineer II
New York Power Authority
James A. Fitzpatrick Nuclear Plant
PO BOX 41
Lycoming, NY 13093-0041
315/349-6960
chapman.n@nypa.gov

Niagara Mohawk Power Corp.
Mr. Carlo J. McClay
Welding Mechanical Engineer
Niagara Mohawk Power Corp.
Nine Mile Station Unit 1
PO BOX 32
Lycoming, NY 13093-0032
315/349-4284

PECO Energy Company
Mr. James D. Hallenbeck
Engineer/Technical Support Section
PECO Energy Company
M/C 63B-3
965 Chesterbrook Blvd
Wayne, PA 19087-5691
610/ 640-5331
jhallenbeck@peco-energy.com

Pacific Gas & Electric Co.
Mr. Michael D. Sullivan
Supv., Welding & Inspection Services
Pacific Gas & Electric Co.
3400 Crow Canyon Rd
San Ramon, CA 94583-1308
510/ 866-5393
mds4@PGE.com

PP&L, Inc.
Mr. Edward Gerlach
Welding Engineer
PP&L, Inc.
Susquehanna Plant
PO BOX 467
Berwick, PA 18603-0467
717/ 542-1824
ebgerlach@papl.com

Southern Nuclear Operating Co.
Mr. Marty Sims
Nuc. Specialist I, Hatch Project Support
Southern Nuclear Operating Co.
M/S B052
PO BOX 1295
Birmingham, AL 35201-1295
205/992-7473
marty.b.sims@snc.com

TU Electric
Mr. Evan Dalasta
Welding Engineer
TU Electric
Comanche Peak Plant
PO BOX 1002
Glen Rose, TX 76043-1002
154/897-5881
edalasta@tuelectric.com

Tennessee Valley Authority (TVA)
Mr. Robert Dana Couch
Engineering Specialist
Tennessee Valley Authority (TVA)
LP 4H-C
1101 Market St
Chattanooga, TN 37402-2801
423/ 751-2867
rdcouch@tva.gov

Wolf Creek Nuclear Operating Corp.
Mr. Steve Sprague
Welding Engineer
Wolf Creek Nuclear Operating Corp.
PO BOX 411
Burlington, KS 66839-0411
316/364-8831
stsprag@wcnoc.com

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TE-110401

Printed on recycled paper in the United States of America

EPRI • 3412 Hillview Avenue, Palo Alto, California 94304 • PO Box 10412, Palo Alto, California 94303 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com