**NRCREP Resource**

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| **From:** | Somers, Charles D. [cdsomers@babcock.com] |
| **Sent:** | Tuesday, December 22, 2009 12:56 PM |
| **To:** | NRCREP Resource |
| **Subject:** | B&W Comments to NRC Draft Regulatory Guide DG-1221 Dated June 2009 |
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Attention:

Rulemaking, Directives and Editing Branch
Office of Administration
U.S. Regulatory Commission
Washington, DC 20555-0001,

Attached please find comments to NRC Draft Regulatory Guide DG-1221 Dated June 2009 (Regulatory Guide 1.43 Dated May 1973) developed by Babcock and Wilcox, Nuclear Operations Group for your consideration.

Should the NRC need to discuss these comments with B&W in further detail, please contact me directly to coordinate these discussions.

Please respond to this E-mail indicating that it has been properly received by the responsible party.

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**Date:** December 29, 2009

**To:** Rulemaking, Directives and Editing Branch
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

**Subject:** Comments to NRC Draft Regulatory Guide DG-1221 dated June 2009 (Regulatory Guide 1.43 dated May 1973)

**Submitted By:** Babcock & Wilcox Nuclear Operations Group, Inc.
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Mount Vernon, Indiana 47620

**Comments:**

**B&W Comments to**
**NRC Draft Regulatory Guide DG-1221 dated June 2009**
**(Regulatory Guide 1.43 dated May 1973)**

While it is understood that the intended purpose of issuing Regulatory Guides is to ensure the safe and continued operation of US commercial nuclear power plants, vague Regulatory Guides can impose unintended restrictions on fabrication techniques. More importantly, a liberal interpretation of a vague Regulatory Guide can result in the technical concern outlined in the Regulatory Guide being ignored with the possible ramifications of decreased reliability, restricted operational parameters, more frequent in service inspections or possible licensing delays.

The current revision of Regulatory Guide 1.43 has been interpreted by some to apply only when stainless steel cladding is being deposited on a coarse grain SA-508 Class 2 forging. This specific base material, as well as SA-508 Class 3, are no longer included as permitted base materials in the ASME B&PV Code and thus cannot be used for new construction. Most knowledgeable manufacturers now require SA-508 forgings to be produced with a fine grain size thereby significantly increasing its resistance to fracture and reheat cracking.

The following are specific technical points concerning the draft Regulatory Guide:

1) The base material nomenclature has been revised in SA-508-05b, a forging base material specification contained in Section II, Part A of the ASME B&PV Code. The SA-508 Class 2 and 3 classifications are no longer utilized. These have been replaced with a classification system which indicates a Grade denoting a chemical composition range and Class indicating a mechanical property range. Since these classifications are the only ones mentioned in the current revision of the Regulatory Guide, some have interpreted it to only apply when stainless steel is being deposited on a coarse grain SA-508 Class 2 forging. The Regulatory Guide should address the revision in the specification nomenclature and very clearly indicate which base materials, by specification, have known susceptibility to underclad cracking.

2) The current revision of Regulatory Guide 1.43 states specifically that reheat underclad cracking has only been observed on a coarse grain SA-508 Class 2 forging. The Regulatory Guide should address the use of fine grain forgings as a method to significantly reduce the susceptibility to underclad cracking.

3) A definition of wide submerged arc (SAW) "wide strip" cladding should be established to provide greater uniformity when evaluating the acceptability of conventional SAW welding procedures. Conventional

SAW strip is commonly recognized as having a 60 mm width. Wide strip is usually considered to be greater than 60 mm. 90 mm and 120 mm are "wide strip" widths presently in use. Strip widths smaller than 60 mm are also utilized, with 30 mm being the most popular. It would be easy to conclude that 60 mm strip need not be evaluated for underclad cracking.

4) A more global definition of "high-deposition-rate" welding processes referred to in the second sentence of the second paragraph of B. DISCUSSION of the draft Regulatory Guide should be developed. The draft Regulatory Guide only mentions submerged arc wide strip and the submerged arc 6-wire welding processes used in the early 1970s. Reference 3 states that reheat cracking has been produced with the semiautomatic gas metal-arc welding process, yet this process is not discussed in the draft Regulatory Guide. Since the early 1970s numerous variations of all of these welding processes have been developed and employed for cladding applications. Electroslag strip cladding (ESW) has replaced submerged arc cladding (SAW) in a number of applications. Both of these cladding processes have further been modified to employ the use of an extended electrode extension (ESO) to reduce weld dilution, increase cladding rates or decrease heat input. As industry moves to utilize more automation, ESW and SAW are being replaced by the gas metal-arc welding process which can be more readily utilized by robotics. Additionally all welding processes can be further modified by adding supplemental filler metal by feeding additional filler wire either cold or electrically heated. This development of cladding procedures continues as lasers are being employed as a supplementary heating source to smooth out the weld deposit in "hybrid" welding process variations. These welding process variations are not well characterized with the conventional calculation for heat input (amperage X voltage X 60 / travel speed). Defining a limit of grain growth in the heat affected zone of the base material should be considered as a screening process for high heat input welding processes. This would limit the number of welding processes that would need to be subjected to the expensive testing procedure defined in C. REGULATORY POSITION and ensure that all high heat input cladding processes are properly evaluated.

5) The third sentence in the second paragraph of B. DISCUSSION of the draft Regulatory Guide incorrectly states "Reheat underclad cracking occurs when the second layer of high-heat-input cladding is added---". The six wire welding process previously utilized by B&W as reported in reference 4 was a single layer cladding process. This report clearly states that the observed underclad cracking occurred in the coarse grain region of the previous weld bead adjacent to the weld overlap of the current weld bead being deposited. This point is reinforced by the examination method described in Paragraph 2d of C. REGULATORY POSITION. This technical error should be corrected.

6) Several manufacturers have successfully utilized a two weld layer cladding procedure to minimize the possibility of underclad cracking. These procedures were intentionally designed to develop a heat input sufficient to either temper the heat affected zone (reduce the base material hardness) or refine the coarse grain size developed by deposition of the first weld layer. This very successful technology is in conflict with the wording in comment 4 above which infers that the second weld layer initiates underbead cracking. The Regulatory Guide should address the use of two weld layer cladding processes to reduce susceptibility to underclad cracking.

7) The third sentence in the second paragraph of B. DISCUSSION of the draft Regulatory Guide which incorrectly states "Reheat underclad cracking occurs when the second layer of high-heat-input cladding is added---"directly conflicts with the first sentence of the third paragraph of B. DISCUSSION which states "Characteristically, the underbead cracking occurs only in the grain-coarsened region of the base metal HAZ at the weld overlap." This also conflicts with the requirement specified in d. of C. REGULATORY POSITION to evaluate "A minimum of two weld clad overlap areas". The discussion in the Regulatory Guide should be revised to clearly indicate that underclad cracking occurs in the weld overlap of the first weld layer.

8) Reference 4 clearly demonstrated that minimal underclad cracking occurs prior to being subjected to a post weld heat treatment and the greater majority of underclad cracking occurs during a post weld heat treatment. Both conventional and enhanced UT examinations are currently used by a number of manufacturers to ensure that the size and distribution of any underclad cracking is below limits justified by engineering evaluations. The Regulatory Guide should state that NDE is only a valid examination if performed after a post weld heat treatment.

9) Enhanced UT examination is currently used by a number of manufacturers to ensure that the size and distribution of any underclad cracking is below limits justified by engineering evaluations. These enhanced UT examinations were not included in early evaluations (mid 1970 thru early 1980) because techniques and equipment required to perform these examinations were not yet available. Techniques and equipment for performing these enhanced UT examinations have been much improved in the past decades. The Regulatory Guide should be strengthened to embrace this NDE examination and to clarify that it is only a valid examination if performed after a post weld heat treatment.

10) Initial construction of commercial nuclear reactor pressure vessels during late 1970 thru mid 1980 extensively utilized plate materials to fabricate heads and shell sections. Plate was rolled and long seam welded to form shells. Plate was hot formed in large presses to form complete heads or head component parts. Forgings were mostly procured for flanges, tubesheets and nozzle belts. During these early fabrication years, most of the large forgings being clad were component parts of the reactor vessel and closure head. So when the issue of underclad cracking surfaced, most cladding of pressure vessel forgings was on parts for the reactor vessel and closure head. It is realized that Regulatory Guide 1.43 applies to reactor vessel and closure head fabrication because of this history. The Regulatory Guide should more clearly state what components it is intended to be applied to.

11) In the fifth sentence of the second paragraph of B. DISCUSSION, a discussion is included where cold cracking was observed when subsequent weld layers of stainless steel cladding were deposited without preheat. These occurrences, although associated with stainless steel cladding, are not germane to the balance of the rest of this discussion. A review of reference 3 indicates that these occurrences deal more with the lack of proper preheating practices which were compounded by high levels of diffusible hydrogen than with high heat input practices initiating reheat cracking. Controls to be enacted to preclude cold cracking and the technical evaluations or qualifications to ensure the adequacy of these controls are much different than controls to be enacted to preclude reheat cracking. Intertwining these two technical issues serves no purpose as C. REGULATORY POSITION provides no discussion of the controls or evaluations to be implemented to preclude cold cracking. A good technical discussion of cold cracking and its prevention is presented in Regulatory Guide 1.50. This documented problem should be discussed in Regulatory Guide 1.50 or a new Regulatory Guide and all reference to cold cracking removed from the draft Regulatory Guide 1.43.

12) Footnote 5 suggests that plate made to a coarse grain practice and a composition similar to SA-508 Class 2 is reported to have exhibited underclad cracking. A topical report outlining the details of this occurrence should be cited. The relevancy of this occurrence can only be ascertained if the technical details are available for examination.

13) Paragraph 2.a of C. REGULATORY POSITION, states "Base material for the test should be of the same grade as that to be used in production." As discussed in Comment 1 above, the current SA-508 material specification identifies base materials with a Grade denoting a chemical composition range and Class indicating a mechanical property range. Most of the materials listed in SA-508 can be procured to either a coarse or a fine grain melting practice. The Regulatory Guide should clarify what changes in base material should be permitted without requalification.

14) Paragraph 3. of C. REGULATORY POSITION, states "Production welding should be monitored to verify compliance with the limitations on essential variables established by procedure qualification." This statement has little meaning because no means of establishing limitations on essential variables established by procedure qualification has been specified. Regulatory Guide 1.43 should require, as a minimum, that the rules of the ASME B&PV Code be applied to define the limitations of essential variables for cladding procedures qualified in accordance with Paragraph 2. of C. REGULATORY POSITION.

In summary, Regulatory Guide 1.43 dated May 1973 does require revision as it is vague and has not been updated to utilize current base material terminology. Since the Regulatory Guide has been issued, numerous vessels have been manufactured by numerous fabricators for the US nuclear industry. Since compliance with this Regulatory Guide was applicable for the licensing of these new components, the position statements for each of these components should be reviewed prior to the finalization of this draft Regulatory Guide. One would expect that new conclusions could be reached concerning procurement of less susceptible base materials, a better definition of "High Heat Input Cladding Processes" and current NDE examinations. The current draft can be improved significantly to remove the vagueness of the current Regulatory Guide.