IS IT TIME FOR A FUSION CODE?

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Background for Richard Barnes

- Chair of Section III “Construction Of Components for Nuclear Facilities” which is a Section of the ASME Boiler and Pressure Vessel Code
- ASME Fellow
- Recipient of the Bernard F. Langer Award
- Recipient of the CNA/CNS Award for Outstanding Achievement
- Recipient of the CSA Award of Merit

Introduction

- Thank you for the opportunity to share some ideas with you
- The development of the fusion process as a source of energy for the production of electricity for the future seems to be getting closer

Background

Background

- ASME BPV Code is concerned mainly about the integrity of the pressure retaining boundary.
- You may ask “What has that to do with Fusion facilities”? – an excellent question. I must admit that the answer is not all that obvious.
- When the Section III Executive was approached by our Japanese colleagues in late 2000 early 2001 to include fusion facilities in the BPV Code, it was heavily questioned.

Background

- Our perspective was - Fusion was still in the development stages, a Code was premature – knowledge of fusion components limited.
- After considerable discussion the BPV Executive agreed to the formation of a new Division under Section III – Division 4 Fusion Facilities – covering fusion components.
- At that time Japan was competing with other countries for the sitting of the ITER project and they thought a recognized Code could be used as a basis for construction.

Background

- The arguments that persuaded the BPV Executive to allow the development of the separate Code were as follows:
  - The time required to develop a Code; this had become a real issue for the BPV Code
  - The difference between a fusion facility and the fission process, the technology, the different types of safety issues etc – it was obvious that a new Code was the correct approach

Background

- A task group of Code experts in materials, design, manufacture, examination (NDE) and process control was formed
- Intense training was provided by the Japanese colleagues
- Agreements on intellectual property were signed between ASME and the relatively newly formed JSME

Background

- A Code outline was developed and the work began in three areas for the Tokomak concept
  - Vacuum Vessel
  - The TF Magnet coils
  - The development of a Quality Assurance Program and development of Code limits
  - Other areas such as the diverter, blankets, cyrostat were to be considered later.

Scope of Initial Effort

- Obviously the question of scope was heavily discussed – which is why we limited the first activity to the three areas mentioned.
- The Code would not cover the electrical aspects of the Tokomak – only be aware of the electrical characteristics that depended on the mechanical equipment to maintain functionality of the process.

Scope of Initial Effort

- The Code was written around the nature of the Tokomak and borrowed heavily from existing Code when that was appropriate.
  - Using existing Code experts who understood the margins and approaches in the existing Code enabled a Code to be developed that targeted directly Tokomak with wording and concepts that would be acceptable to other Code Committee members – voting process

What Happened

- Japan was not successful in winning the site and so the development of the Code stopped except that JSME decided to complete the development of the magnet part of the code – this was completed and since then JSME has continued with this development independently.
  - Section III did not remove Division 4 immediately – about a year later the Subgroup on Strategy and Project Management decided to revisit the concept of a code for fusion facilities and began the process of code development.

Is it time for a Fusion Code?

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WHEN IS A CODE USEFUL?

- Safety
  - Radiological issues
    - Tritium handling and storage
    - Activated products handling, storage and disposal
- Economics
  - ITER very large facility; very large investment
  - International involvement and investment
  - Complex financial arrangement

Is it time for a Fusion Code?

- Control of Construction
  - Shared construction
  - Shared responsibility
  - International construction
  - Consistency in construction
- Regulatory Requirements
  - Regulators prefer requirements that can be enforced

Concerns with a Code

EXPERIENCED PUSHBACK AGAINST A CODE

- Injects a structure that must be followed
- Limits creativity
- Often associated with Government control
- Technology still under development
- Maybe not as rational – people do not like the control

When there is NO Code

When there is NO Code

- People look for codes that are in existence and copy parts or pieces of them
- Codes are developed with a consistent approach e.g., Section III has requirements for:
  - Materials
  - Design
  - Manufacture & Installation
  - Examination
  - Testing
  - Consistent General Requirements e.g., Design Specification, Quality Assurance, Independent Inspection

When there is NO Code

- Unless you understand this you run the risk of a severe inconsistency
  - What failure mechanisms are covered
  - What margins are present
  - Are they adequate?
- Unless this is understood there are risks of severe inconsistency
  - What failure mechanisms are covered
  - What margins are present
  - Are they adequate?

When there is NO Code

- Are there disconnects?
  - Is the design properly connected with the manufacturing and the examination?
- Have the risks been minimized?

Consequences

Failure can lead to

- Government intervention
- Unfortunate publicity
- Reduction in public support
- Elimination of funding
- Loss of support from Government and Industry

What does the ASME BPV Code Offer?

What does the ASME BPV Offer?

- **An open system**
- **Code development experience**
- **Input from personnel with extensive experience in building large projects usually on time**
- **Strong technology skills**
- **Well respected by the lawmakers and financial contributors**
- **Cooperation with other Standards Development Organizations**

What does the ASME BPV Offer?

The ASME BPV Code is a very robust Code and has international standing for its excellence and integrity.

The elements that contribute to this are several:

1. A committed set of volunteers. The Code committee meetings are open to anyone attending who can contribute to the meeting.
2. The support of industry who allow their employees to participate by providing the time and economic support.

What does the ASME BPV Offer?

3. The open balloting with its checks and balances including the requirement that the approved items be presented for public comment.
4. A committed fulltime support staff that assist in the maintenance of the process and maintain adherence to operating procedures monitored and approved by ANSI.

What does the ASME BPV Offer?

5. A conformity assessment process that ensures adherence to the implementation of the code requirements in construction.
6. An oversight committee structure that ensures the process is maintained intact and plans for future development
7. A system that defines responsibility and ensures accountability by those with certification to produce the product in accordance with the Code requirements.

Status

Status – Code Development

- Subgroup charged with the management and development of a Code for Fusion Facilities
  - Meets four times per year
- International membership in the Subgroup
  - Representatives from Asia: Japan, China, South Korea, India
  - Representatives from IAEA, UKAEA
  - Representatives for the US: INL, Lawrence Livermore, Princeton
  - US manufacturing organizations

Status – Stakeholders Group

- **Objective: The purpose of these Stakeholder meetings is to**
  - **report on the committee progress of the Code development,**
  - **identify obstacles to code development,**
  - **identify research and development needs,**
  - **receive feedback from industry on the Code approach,**
  - **receive feedback on the current industry needs, and**
  - **maintain current with any new directions that industry is contemplating so that the Code can be responsive to the current needs of industry.**

Status – Roadmap Developed

- ASME has established a Roadmap to guide the development of the Code
  - It will provide a systematic and controlled development of the Code
  - It will be the responsibility of the Stakeholders Group to keep the Roadmap updated and followed

Conclusion

- It is time – it is needed
- It must be a broad community effort to achieve the best results
- A Code will offer a disciplined approach to the construction of the DEMO project and be the collection point for experience gained and used for future facilities.
- ASME has continued to include the international community and the industry to ensure that any code produced represents the need of society
- One other thought – finance: smaller is better from an investment aspect.

Thank you for your attention