A CRITICAL ASSESSMENT OF CODES AND STANDARDS FOR NUCLEAR AIR AND GAS TREATMENT

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Abstract

In 1998, the ASME Committee on Nuclear Air and Gas Treatment (CONAGT) celebrated its 22nd anniversary.

This paper will review and assess ASME Nuclear Codes and Standards for Nuclear Air and Gas Treatment produced by CONAGT during those twenty plus years. In addition, other codes and standards that impact Nuclear Air and Gas Treatment will be touched upon.

The authors of this paper have collaborated to assess not only the Codes and Standards, but also the processes used to produce them and the customer interface; i.e., whether or not these Codes and Standards have aided in producing safer nuclear power plants and nuclear facilities.

I. Background

The ASME Committee on Nuclear Air and Gas Treatment is responsible for the generation and maintenance of four codes and standards that address Nuclear Air and Gas Treatment;

- ASME - AG-1 [1] - this is the most inclusive document the Committee produces. The details of the coverage are shown in Figure 3-1. Papers that follow this one will detail the particulars of each section of the code.
- ASME N509 - Nuclear Power Plant Air Cleaning Units and Components [2]
- ASME N510 - Testing of Nuclear Air Treatment Systems [3]
- ASME ?? - Inservice Testing of Nuclear Air Treatment Systems [4]

There are many other codes and standards that support these four by reference. This paper is not intended to address these documents with the exception of one - ASTM - D3803, Standard Test Methods for Radioiodine Testing of Nuclear Grade Gas - Phase Adsorbents. [5]

II. Assessment Discussion

The Authors of this paper assessed CONAGT's Codes and Standards by asking, and collectively answering, the questions that follow.

1. Are these Codes and Standards beneficial to the Nuclear Industry? Have they produced safer nuclear power plants and nuclear facilities?

The benefits that the Codes and Standards that CONAGT has produced for the industry are:

(a) High quality products,
(b) Consistency in products, regardless of manufacturer,
(c) Consistency in design of products, regardless of designer, and
(d) Provides the necessary guidance to ensure that all design criteria and environmental conditions are addressed by the owner, architectural / engineering firms, and manufacturers.

These benefits did not exist before CONAGT produced their Codes and Standards, particularly ASME N509 and N510. Air cleaning systems design and manufacture in the days before these Standards was not standardized enough to make testing to the requirements of N510 readily feasible. However, the guidance of N510 for testing is still a better alternative than no standardized guidance. It should also be recognized that ASME N509 and N510 are referenced in NRC Regulatory Guide 1.52 [6] and in the Technical Specifications for most U. S. Operating Nuclear Power Plants.

ASME AG-1was published later in the design / build phase of current U. S. nuclear power plants. Unfortunately, the Three Mile Island Accident, and later the Accident at Chernobyl, prompted cancellation of many new plants and placement of no new U. S. plant orders.

Therefore, use of ASME AG-1 has been very limited in the U. S. The use of this Code is far more accepted outside the U. S. and will be addressed later in this paper.

The answer to the second question requires a more subjective assessment. The air cleaning and treatment systems primary design function is to serve as the last line of defense against the release of radioactivity. Given the defense-in-depth concept of the design required for reactors, there has been only one test of the air treatment systems and that was at Three Mile Island. Even there, with an old design, and less than perfect maintenance, the system performed its function. Therefore, the answer to this question is a subjective "yes".

2. Were these Codes and Standards produced in a timely fashion?

The answer to this question has been partially given in number 1. CONAGT was created relatively late in the design / build phase of U. S. nuclear power plants and the events which led to plant cancellations and no new plant orders occurred about the time that ASME AG-1 was originally published. Therefore, it is difficult to answer this question for the U. S. market. For the international market, in particular, Asia, it is easier to answer and will be discussed in question number 5.

Overall, the answer is "yes". The consensus process used by ASME in the development of Codes and Standards by nature is time consuming. However, it assures adequate technical input, review and discussion of all portions of the Code or Standard by all involved and interested parties. This process eliminates individual preferences, commercial bias, and assures that technical and administrative content will be more globally accepted.

One particular Code Section should be addressed. That is the Testing Section, TA. [7] Originally this section of ASME AG-1 was conceived to cover all aspects of acceptance and inservice testing for nuclear air and gas treatment systems. When the original draft of this section (which had been approved by CONAGT) was presented to the ASME Board of Nuclear Codes and Standards (BNCS), the BNCS objected to the combination of these two areas of testing. Due to Board policy on acceptance and inservice testing, this document was divided into two different documents as was, and still is, the way other BNCS Nuclear Testing Codes and Standards are divided. The Board directed CONAGT to split the TA Section into two documents to maintain their policy.

CONAGT worked to split the TA Section into the two documents as directed by the Board. One document, Section TA, covers pre-operational acceptance testing. This document has been completed and has been incorporated into ASME AG-1. The second document will be a new standard to cover inservice testing. This document has been initially balloted by the CONAGT Main Committee and negative ballots are currently being resolved.

What is not readily apparent from the foregoing is the time lag that has occurred between the original submittal to the BNCS and the current status. This time lag has been several years and most of the responsibility for the lag rests with CONAGT. Internal resistance to the directed changes has been the cause. These changes were viewed as unnecessary and demotivating. The causes not withstanding, the result is that the CONAGT document that the current industry would have the most potential use for, and for which NRC may be most interested in endorsing, the standard on inservice testing, is not yet published.

3. Has user input been solicited and incorporated into these Codes and Standards?

Several examples of the methods that CONAGT has used, and continues to use, to ensure that user input has been solicited and incorporated into these Codes and Standards are:

a) Committee meetings. These meetings are all "open meetings"; meaning any interested party can attend and be heard. While interested parties cannot vote on matters of the Committee, their input and thoughtful insights are carefully evaluated and acted upon by the Committee. Many previous visitors have been elected to the Committee and now serve the Committee in an official capacity.

b) CONAGT held two industry interface meetings in 1985 when many U. S. nuclear plants were beginning to operate. From these meetings, the Committee gained valuable operational input which resulted in revisions to ASME N509 and N 510 that have helped make these standards better for industry use.

c) ASME Inquiry Process. ASME employs a standard process that allows any individual to ask questions about their Codes and Standards. The major problem with this process is the speed (timeliness) that answers are fed back to the inquirer. This process will be discussed in more detail in question number 4.

d) A primary source of input for CONAGT has been from the NRC / DOE Nuclear Cleaning and Treatment Conferences. This is the 25th Conference and spans the last fifty years! The papers presented at this conference, the participation by international experts in the field of nuclear air cleaning and treatment, and the formal and informal exchanges between these experts has produced a wealth of information and ideas that have helped CONAGT produce more refined Codes and Standards, as well as providing a forum to keep abreast of developments in nuclear air cleaning and technology in most of the countries using nuclear power.

e) CONAGT also sponsored a number of ASME Professional Development training courses where considerable valuable feedback was obtained through interaction of the CONAGT instructors and the attendees. Written feedback was also obtained by use of a questionnaire at the end of each course.

Aside from the standard methods listed above, a key aspect is the Committee members themselves. Noted authorities, company specialists, users, owners, researchers, designers, manufacturers and test personnel make up the Committee. These are people who have dedicated their life's work to air cleaning activities. Daily, real problems and issues are addressed and solutions are found. This process helps shape the codes and standards by identifying needs. Then solutions are identified, including revisions to the codes and standards. CONAGT has also been very successful in gaining broader input and expertise for our Codes and Standards by actively and successfully soliciting new members at all levels. When we find areas that need coverage by CONAGT we have been able to find highly qualified people from those areas to join our writing effort.

4. Are Codes and Standards Inquiries handled in a timely fashion?

CONAGT has not been successful in sufficiently timely responses to inquiries.

CONAGT has recently used an "inquiry committee" process that, by ASME procedures, allows a special team of experts be designated to prepare an answer to the inquiry for voting by the Main Committee. This has resulted in faster responses to inquiries than the previous method which assigned the inquiry to a subcommittee, going through their concensus process, and then gaining Main Committee concensus.

ASME is now implementing a redesigned consensus process that should result in more timely responses to inquiries, as well as making revisions to existing Codes and Standards, and producing new Codes and Standards. The central focus of this redesigned process is to get wider circulation and input early in the draft preparation, and to get review by technical experts and interested parties in parallel with the preparation rather than in series which is the current process.

5. Are these Codes and Standards used internationally?

ASME is very active internationally. The Board on Nuclear Codes and Standards (BNCS) established a committee to promote research and development to improve nuclear codes and standards for the enhancement of nuclear safety. The International Inter-Society Research Committee (IIRC) was established with members from Europe, Asia, and the Americas whose function is to:

a) Promote international exchange of information on research related to nuclear codes and standards

b) Create synergy, avoid duplication of effort and leverage resources among international organizations conducting research related to nuclear codes and standards;

c) Expand international participation in research related to upgrading nuclear codes and standards; and

d) Contribute to achieving international consensus on nuclear codes and standards

For the past 20 years new construction in the nuclear industry has been predominantly limited to Asia. With the current economic crisis in Asia, the pace of new construction has greatly reduced, but has not stopped. The codes and standards are used internationally in various degrees as follows:

Korea

Korea has embraced the ASME Codes due mainly to the efforts of U. S. architectural engineering firms such as Bechtel, Sargent & Lundy, and Stone & Webster. Four (4) plants have been built to ASME Codes and Standards, Yongwang Unites 3 & 4 (YGN 3 & 4) and Ulchin Units 3 & 4. Four additional plants under construction, YGN 5 & 6 and Ulchin 5 & 6 specify ASME Code AG - 1 and ASME N509. Recently completed Wolsong Units 2, 3 & 4, Canadian Candu 6 Reactors, specified Canadian Standards but accepted ASME Codes and Standards.

Taiwan

Due to the heavy U. S. influence, nuclear plants in the Republic of China (ROC) specify ASME Codes and Standards. Taiwan Power Company is currently constructing Lungmen Units 1 & 2 and ASME Codes and Standards are specified.

China

The Peoples Republic of China (PRC) does not specify ASME Codes and Standards. Qinshan Units 1 & 2, Canadian Candu 6 Reactors, specify Canadian standards but will accept ASME as an alternate.

Japan

Japan utilizes ASME Codes and Standards selectively. ASME Section III has been specified since the 1970's. ASME AG - 1 is not widely used.

Canada

Canada, with its successful CANDU power reactor program, follows CSA Standards. The CSA Standards relate closely with ASME Codes and Standards. Canadian regulators generally accept ASME Codes and Standards when provided with a matrix showing equivalency. ASME Codes and Standards are in use and acceptable in Canada but not fully adopted.

Europe

The authors are not aware of the use of CONAGTs Codes and Standards in Europe.

6. Are there Codes and Standards used in other countries that CONAGTshould review and evaluate for potential use?

It is the current opinion of the authors of this paper that there generally are not. However, one possibility that will be discussed by CONAGT is to appoint a task force to review Canadian and European standards. The objective would be to look for similarities so that we could offer for adoption by ASME AG - 1 by showing compliance with regional or national standards.

7. How does the Regulatory Process address (endorse) these Codes and Standards?

The USNRC invokes the use of ASME N509 and N510. As noted earlier in this paper, these two standards are referenced in Regulatory Guide 1.52 and in most operating nuclear plant

Technical Specifications. However, most plant Technical Specifications and Regulatory Guide 1.52 reference outdated versions of ASME N509 and N510.

There are no new plants so the industry is moribund. With no industry driving force, the NRC has not maintained the existing Regulatory Guides and takes years to do anything about problems the industry has brought to them. The radioiodine testing situation CONAGT uncovered approximately 15 years ago (and still exists) is a prime example of a problem that should have been corrected in a year or two. Regulatory Guide 1.52 has been outdated for two decades now. It is very obsolete and refers to obsolete documents including some CONAGT documents. There is no apparent reason for at least updating the document references.

The NRC and DOE often invoke CONAGT documents incorrectly. N510 clearly states it is only to be rigorously applied to systems built to N509-89; however sections may be used for technical guidance for testing air treatment systems designed to other criteria. Therefore, it cannot be applied to the letter for Non-N509-89 systems.

In addition, the NRC has never reviewed ASME AG-1 for adoption by regulation. There appears to be no emphasis by the NRC to acknowledge this Code for use by the next generation of nuclear plants, even though it is the authors understanding that it is cited by reference in the specifications for some of these later designs.

8. What significant technical issues have these Codes and Standards addressed?

In the early days of writing N510 we had a serious technical error in the use of the theory for housing or bank leak tests. The equations and physical reality of actual and calculated leak rate to temperature sensitivity was not understood by the Testing Subgroup or Subcommittee. Paul Estrich and Bob Raber who were on the Committee at that time educated us to understand the problem and correct the test methods and supporting theory. This resulted in a significant change in the acceptance criteria for housing leak tests. This new and correct understanding led to the realization that the test was about an order of magnitude less accurate for low leak rates than previously believed. The acceptance criteria were revised to recognize this limitation and cautions were added to the Standards.

The laboratory testing of activated carbon used in nuclear air cleaning adsorbers was also a significant problem that was addressed by CONAGT. An effort led by Dr. Melvin W. First of the Harvard School of Public Health identified inconsistencies in laboratory testing for radioiodine retention. A series of round-robin tests of carbon confirmed the problem. The results of this round -robin were first presented to the NRC by CONAGT in the mid-1980s. This resulted in an additional series of tests by INEL, and eventually resulted in a revised standard for this testing, ASTM-D3803-1989.

This problem was again presented to the NRC by members of ASME staff and CONAGT in 1993 because most operating nuclear plant Technical Specifications still referenced (and still do reference) the earlier version of this standard. The NRC has recently acknowledged this problem in a proposed Generic Letter. The question remains as to the final solution and why it has taken the NRC five years to respond to the issues.

The original scope of coverage for CONAGT was the state of the art at that time and covered equipment that the Committee knew should be covered. As the Committee prepared AG-1, it became obvious that additional equipment and technical items needed to be covered. Some examples of expanded coverage that resulted are:

a) Structural design and qualifications covered in the AA-Section of AG-1. [10] This is one of the most extensive documents on structural design for various loadings, including seismic, known to exist, and the only one known to exist for nuclear air treatment components and ductwork.

b) Instrumentation and Control. This section that addresses instrumentation and control components for nuclear air cleaning and treatment was an added scope item.

c) Housings for nuclear air cleaning and treatment systems were originally included with ductwork. It soon became apparent that these major differences between the two and the housings were separated into their own section of ASME AG-1.

d) Section FC (HEPA Filters) of AG-1 has been revised to incorporate the requirements of MIL-Specifications F-51068 and F-51079 allowing the deletion of these two U. S. Government Standards.

e) Several new sections on other types of filters (adsorbers, special NEPAs, Low Efficiency) are currently being written by the Committee.

9. What significant technical issues have these Codes and Standards NOT addressed?

a) Testing of Non-ASME N509 Systems.

It is the opinion of one of the authors of this paper that one of the most significant technical issues that CONAGT has not successfully addressed is the testing of Non-ASME N509 systems.

The problem is being required to test a system per the requirements of N510 that has not been designed and built to the letter of N509. The "Scope" (Section 1) of N510-89 states "This Standard covers the testing of ASME N509 high efficiency air treatment systems for nuclear power plants". The "Limitations of the Standard" (Section 1.2) states in part "This Standard ***SHALL*** (emphasis added) be applied in its entirety to systems designed and built to ASME N509 specifications". Similar statements are in all earlier editions of N510. CONAGT is responsible for these Standards and has specifically written these Scope and Limitation Sections as carefully as possible to indicate the intent of N510 is that it be applied to nuclear air treatment systems designed and built to the corresponding edition of N509. The Limitation Section of N510 states that sections of N510 "—***MAY*** (emphasis added) he used for technical guidance for testing air treatment systems designed to other criteria." Note the difference between the imperative "SHALL" and permissive "MAY". In codes and standards "SHALL" means that something is mandatory, "MAY" only indicates it is permissible. Regulatory mandates that permissive technical action be mandatory are the basis of the problems and suffered by much of the industry. If tests are not technically or physically possible then "mandates", from what ever source, do not make them possible. Of course physical modification may be made to the subject systems to bring them into compliance with N509. This is often the best answer to the conundrum but neither an easy or inexpensive one.

Therefore, the problem is being required to perform tests using a standard that is incorrectly invoked (i.e., verbatim compliance) on a system not designed or built to the required companion standard. To date, this issue has not been resolved.

b) The Gas Processing Section of the AG-1 Code was started by two groups. One was a Gas Processing Equipment Subcommittee and the other a Subgroup of the Testing Subcommittee. The personnel were essentially the same on each group. They worked for nearly a decade preparing drafts of these sections from the late 1970s. At the time there was resistance from some of the members of the writing groups to "codifying" anything

related to Gas Processing. They were successful and have delayed efforts in this area for many years. More recently a new Gas Processing group has been reconstituted to cover the areas of Gas Processing that are of interest to DOE. So far they have been productive.

c) Another unsuccessful area for CONAGT was to have a standard that defined the technical training and experience required to be qualified for N510 and, later, AG-1 Section TA testing. The basic industry documents used define periods of experience and training but say nothing about the technical content of the experience or training. CONAGT had a group chaired by Dr. First of Harvard write an excellent draft that was not approved by the Main Committee. This was the result of utility member resistance. After years of meetings with utility personnel and repeated drafts, the effort was abandoned due to unrelenting utility resistance to this document. The final draft was published in the 20th Air Cleaning Conference Proceedings. [11]

10. What is the current and future customer base for these Codes and Standards?

a) The most active users for the CONAGT Codes and Standards are currently the Department of Defense and Department of Energy. Both use many filtration systems that fall under the technical umbrella of the CONAGT documents or are technically close enough to nuclear power plant systems that CONAGT is working to expand the scope of its current documents to include them.

Department of Defense uses many filtration systems very close to those in nuclear power plants for protection from chemical, biological or radiological attack. The size and flow rates vary dramatically from application to application but the requirements for integrity, leak-tightness and operability are consistent. Some special applications such as destruction of old chemical weapons stocks requires considerable modification of the details of the system design, use of multiple adsorber banks in series for example, but the overall code and standard requirements are the same as for the traditional nuclear power plant filtration systems.

Department of Energy has a wide variety of detail systems and application but again the objectives and requirements for integrity, leak tightness and operability are common. There are additional chemical and radiological restraints added in many cases but nearly all fall under the CONAGT umbrella.

b) Operating U. S. Nuclear Power Plants. These plants require the use of ASME N509 and N510. Discussions on the use of these documents, their outdated reference in regulation and the compliance issues have been covered earlier.

c) Future Nuclear Power Plants. ASME AG-1 appears to be nicely positioned for use by future plants, both in the U. S. and other countries. CONAGT must pay particular attention to the use of its documents in new plants being constructed in Asia and response to customer input from this source.

d) Other potential users for the Codes and Standards are nuclear medicine and other nuclear facilities. Future customer contact will be planned by CONAGT, as resources permit.

11. How is the CONAGT Committee addressing these future needs?

CONAGT has, for many years, addressed future needs in its Strategic Plan. Recently, CONAGT has been in the process of re-evaluating its strategic direction. Originally, the direction was to complete the original scope and coverage and to promote its Codes and Standards internationally.

The original scope is now almost complete. The last major work will be to issue the new standard covering inservice testing of nuclear air cleaning and treatment systems and to resolve gas processing. Promotion of ASME AG-1, ASME N509 and N510 internationally is ongoing and appears to be better accepted in Asia.

CONAGT must now focus its efforts on:

a) Maintaining its Codes and Standards technically current,
b) Addressing the needs of current users (primarily, operating nuclear power plants),
c) Completing the original scope of CONAGT which includes resolving the Gas Processing issues and completing the new standard on inservice testing,
d) Addressing the needs of other domestic users such as Department of Energy and Department of Defense, and
e) Focus more efforts on gaining wide usage of CONAGTs Codes and Standards by the international community.

III. Conclusions

- The Codes and Standards produced by CONAGT are beneficial to the nuclear industry.
- In general, these Codes and Standards were produced in a timely fashion. Industry events diminished their potential value for future U. S. nuclear power plants. One particularly valuable Standard for Inservice Testing of Nuclear Air Treatment Systems has been unavailable to the industry due to reasons mostly within CONAGT's control.
- User input has been obtained and incorporated into these Codes and Standards. This input has resulted in improved products.
- The process for handling production of codes and standards, revisions and inquiries is thorough, but slow to react to user needs. ASME process redesign currently being implemented to address timeliness and still maintain the consensus aspects of the process should improve future timeliness.
- ASMEs (and CONAGTs) Codes and Standards acceptance and use by the international community varies. In Asia, there is better acceptance and use than other areas of the world, due primarily to the strong influence of U. S. architectural and engineering firms.
- USNRC acceptance and use of CONAGTs Codes and Standards needs to be improved dramatically.
- CONAGT has demonstrated strong technical leadership in some issues while faltering on others. Overall, the Committee has done an commendable job in this area when one considers the quality of its primary products (ASME AG-1, N509 and N510).
- CONAGT is planning for the future. They are not relying on the utility customer base to sustain them. They are actively seeking and serving new customers such as the Departments of Energy and Defense, and the international community.

IV. Recommendations

- Produce the new Inservice Testing Standard and actively seek USNRC acceptance as soon as possible.
- Continue to seek ways to gain USNRC, Department of Defense and Department of Energy acceptance of ASME AG-1. Also, continue to work with the NRC to upgrade its use of ASME N509 and N510.
- Implement, and model, the ASME Redesign Process.
- Continue the practice of seeking and implementing user input.
- Continue to identify new customers, bring them into the Committee structure and take action on specific activities to address their needs.

- Continue to maintain CONAGTs Codes and Standards to state-of-the-art.
- More aggressively promote the use of CONAGTs Codes and Standards internationally;
  - ⇒ Recruit international members for CONAGT
  - ⇒ Assign a task force to review Canadian and European codes and standards and integrate with CONAGTs Codes and Standards
  - ⇒ Continue to seek input from users in Asia.

References

(1) ASME AG-1, "Code on Nuclear Air and Gas Treatment", ASME, 345 East 47th Street, New York, NY 10017

(2) ASME N509, "Nuclear Power Plant Air-Cleaning Units and Components", ASME, 345 East 47th Street, New York, NY 10017

(3) ASME N510, "Testing of Nuclear Air Treatment Systems", ASME, 345 East 47th Street, New York, NY 10017

(4) ASME ??, "Inservice Testing of Nuclear Air Treatment Systems", (Title and Standard number yet to be finalized), ASME, 345 East 47th Street, New York, NY 10017

(5) ASTM D3803, "Standard Test Method for Nuclear-Grade Activated Carbon", American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103

(6) USNRC Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units for Light- Water-Cooled Nuclear Power Plants", Rev. 2, March 1978, United States Nuclear Regulatory Commission, Washington, D. C. 20555

(7) ASME AG-1, Division IV, "Testing Procedures", Section TA, "Field Testing of Air Treatment Systems", ASME, 345 East 47th Street, New York, NY 10017

(8) Military Specification MIL-F-0051068F, "Filters, Particulate (High Efficiency, Fire Retardant)"

(9) Military Specification MIL-F-0051079B, "Filter medium, fire-resistant, high-efficiency"

(10) ASME AG-1, Division I, "General Requirements", Section AA-4000, "Structural Design", ASME, 345 East 47th Street, New York, NY 10017

(11) Proposed Appendix C to ANSI / ASME N510-1986, "Qualifications of Field Testing Personnel for Nuclear Air and Gas Treatment Components and Systems (nonmandatory)", 20th Nuclear Air Cleaning Conference, pages 1262-1267, CONF-880822, National Technical Information Service, Springfield, VA 22161-0002

Figure 3-1

SCOPE OF COVERAGE OF ASME AG-1

DIVISION I

-General Requirements
-Subsection AA - Common Articles

DIVISION II

-Ventilation Air Cleaning and Ventilation Air Conditioning
-Section BA - Fans and Blowers
-Section DA - Dampers and Louvers
-Section SA - Ductwork
-Section RA - Refrigeration Equipment
-Section CA - Conditioning Equipment
-Section FA - Moisture Separators
-Section FB - Prefilters
-Section FC - HEPA Filters
-Section FD - Type II Adsorber Cells
-Section FE - Type III Sorbers
-Section FF - Adsorbent Media
-Section FG - Frames
-Section FH - Other Adsorbers *
-Section FI - Metal Media Filters *
-Section FJ - Low Efficiency Filters *
-Section FK - Special Round and Duct Connected HEPA Filters *
-Section IA - Instrumentation and Control

DIVISION III

-Process Gas Treatment *
-Section GA - Pressure Vessels, Piping, Heat Exchangers and Valves *
-Section GB - Noble Gas Hold Up Equipment *
-Section GC - Compressors *
-Section GD - Other Radionuclide Equipment *
-Section GE - Hydrogen Recombiners *
-Section GF - Gas Sampling *

DIVISION IV

-Testing Procedures
-Section TA - Field Testing of Air Treatment Systems
-Section TB - Field Testing of Gas Processing Systems *
-Section TC - Personnel Qualification *
-Section TD - Laboratory Qualification *

* In the course of preparation