September 22, 1981
GCRA/DO-0C-0376

Ms. Helen Field
Procurement Officer
U.S. Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, CA 94612

Subject: Summary Report on Review of Technology Development Plans,
DOE/GCRA Contract No. DE-AC03-78SF0034

Dear Ms. Field:

The subject report, a deliverable under Work Element Definition 02
(MSSR 02.5), is forwarded to meet contractual requirements. A copy is
also provided for information and comment to cognizant DOE personnel with
programmatic interest. If additional information is needed, please contact
me at (714) 455-9500.

Sincerely,

[Signature]

L.S. Masterson
Contract Administrator

LSM/es
Enclosure

cc: C. Beighley, DOE/SAN-San Diego
    S. Harbison/W. Von Flue, DOE/SAN
    G. Newby, DOE/HQ, NPD
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Dr. A. J. Goodjohn  
General Atomic Company  
P. O. Box 81608  
San Diego, CA 92138

Subject: GCRA Comments - HTGR-SC/C Design and Technology Development Plans

Dear Al:

GCRA has approached the initial review of the subject plans from the vantage of Utility/User interests in an HTGR-SC/C Lead Project as characterized in the HTGR-SC/C Lead Project Plan. At their current stage of development, the plans are considered to represent the early views of General Atomic Company, acting as a potential NSSS vendor, on the effort necessary to design and license an HTGR-SC/C plant. As such, these plans embody GA's perception of the level of technical development and demonstration needed to support the cost and risk sharing assumptions in the Lead Project Plan.

These plans and the plant design which they address will be subjected to a more formal review by other vendor and Utility interests in the course of establishing the Project Decision Package scheduled for June 1982. The culmination of these review activities will be the adoption of this information by all participants as the HTGR-SC/C Program Baseline. This process will require that Program participants express their understanding and endorsement of the Program, including risks associated with the Lead Project designed, licensed, and constructed in accordance with these plans before senior Utility, Congressional, and DOE officials. It will also be necessary to endorse these plans as supporting a management framework that is compatible with both a government-funded development program and with private sector cost and risk assumptions of the Lead Project Plan. Thus, at this stage GCRA's general comments are oriented to:

- The usefulness of the plans for communicating the technical basis upon which the Program and Project will be committed.
- The usefulness of the plans for establishing a management framework with appropriate time-phasing and interface definition.

While specific comments have been developed in selected areas, we believe the appropriate forum for rigorous scrutiny of technical content is in the forthcoming Review Meetings.
September 8, 1981

Dr. A. J. Goodjohn

If you have questions concerning the intent or disposition of the enclosed comments, please contact me or Harold Gotschall.

Sincerely,

L. D. Mears

LDM/HLG: pm
Enclosure

cc:  G. Newby, DOE-HQ (GCRA/DOE-HQ-0144)
     W. Von Flue, DOE-SAN (GCRA/DOE-OC-0369)
     C. Craig, GE (GCRA/GE-0141)
     C. Storrs, CE
     P. Kasten, ORNL (GCRA/ORNL-0087)
     E. Arbtin, EG&G

bcc:  Tech. Staff
Review of Draft HTGR-SC/C Design and Technology Development Plans

I. General Comments

1. In their present form, the Design and Technology Development Plans are not amenable to meaningful review for scope and content. The Design Plan narratives in particular do not succeed in communicating the major elements of component development strategies. It is recommended that future issues be drafted around a summary schedule that integrates supporting Technology Program work and that text and references be provided to orient the reviewer and characterize status.

2. The key Utility interface and end product of design work are drawings, specifications, design reports, etc. (i.e., the information formerly contained in GA's Customer Software Schedule). This information is the tie to BOP engineering and construction. Likewise, the key design interface and end product of technology work are completed data bases, tests, etc. (i.e., the information presented in Design Data Needs Documents). It is recommended that milestone selection be reviewed to provide for appropriate visibility and integration of these end products. A summary of Design Data Needs and Major Document Issues should be included for each component/system in Section 6 of the Design Plan.

3. Narratives should also provide a guide to the use of networks. In this context, it is recommended that a disciplined use of phase terminology be introduced (conceptual, preliminary, final) and that appropriate milestones for specific components/systems be included in both the narratives and networks. Particular emphasis should be given to describing projected status at key programmatic commitment points, i.e., project initiation and start of construction. (A programmatic decision on the use of DOE nomenclature and structure is pending.)

4. A concise technical description of the plant should be included in the Plans. The incorporation of the plant TED or a suitable extract should be considered.

5. A comparison of early- and late-start cash flow requirements at Program inception (FY81) shows very large differences (about $40M/yr). This suggests that either much work (particularly in Technology Programs) is not schedule constrained in the early years, hence deferrable, or that network ties were inadequately defined at the time the calculations were made. In either event, these differences require further interpretation. (Cash flows at WBS Level 3 should be included in the Technology Plan.)

6. The prioritization matrix used in the development of Design Data Needs and formulation of Technology Program activities should be extended to include design activities. Capability to summarize and review planned work within this framework should be developed.
7. An explanation of apparent increases in projected Design and Technology Development costs from $350M ('80 $) to about $460M ('81 $) is needed (separate correspondence). The explanation should be characterized by component/system, WBS Level 3, and the categories in the prioritization matrix.

8. A circumstance of possible double accounting of field support activities contained within the Design and Technology Plans and indirect costs as presented in the Lead Project Plan requires review between GA and GCRA staffs under separate correspondence.

9. Key Utility/A-E interfaces in Systems, Licensing, and Construction will be the subjects of ongoing reviews.

10. With regard to Section 7, "Facilities," in the Technology Plan, it is recommended that a planning activity involving Program participants be undertaken to categorize facilities and types of tests and establish a planning framework. Planning networks should be developed to describe the sequence of activities necessary to acquire and use capital equipment, i.e., specification, authorization, acquisition, installation, etc. The resulting network(s) should then be related to capital equipment cash flows.

11. With regard to Section 4.1 in the Technology Plan, the summary network for the "Core Support Graphite Stress and Oxidation Issue" should include more specific information. Considering the importance of this issue, the plan for resolution (Fig. 1) seems rather vague.

12. With regard to the Technology Plan, Section 4.5, "Fission Production Transport Prediction Issue," while the technical description of the issue and plan for resolution are adequate, the importance assigned to this issue is not clear. It is recommended that a qualitative description of the consequence of not resolving this issue be provided in terms of impact on plant performance, economics, and safety.

13. With regard to the Technology Plan, Section 6.4.4.4, the second paragraph opens, "The machine will be designed and fabricated under the HTGR Applications Program." It is assumed that fabrication costs of the (wire winding) machine are borne by the Project as soft tooling costs. If so, the above wording should be revised.

14. With regard to the Technology Plan, Section 6.4.3, "Fuel Handling Machine DV&S," it is noted in the text that the effort projected to qualify the FHM does not reflect a thorough evaluation of the in-vessel system and that only $400K capital costs are currently expected. Considering the rather significant departure from Fort St. Vrain precedent and the importance of this area to Utilities, please advise us of your current thinking prior to the Review Meetings.
II. Specific Comments

1.0 Section 1.0 through 5.0

1.1 Inconsistencies in the document title between the cover and title page and elsewhere in the report should be resolved.

1.2 Table of Contents
   a) Section 6.16 omitted.
   b) References are incomplete and poorly titled. Also, the references are frequently identified in text by Arabic rather than Roman symbols.

1.3 Introduction
   a) Cover says Design Plan, title page says Design Development Plan, introduction leads off calling it a Design Program.
   b) Last paragraph, Reference II should be Reference VI?

1.4 Section 2
   a) Title includes Document Tree but was otherwise omitted. Inclusion of the Document Tree, including summary descriptions for each document, should be provided for identifying the major end products for each of the design activities.
   b) Use of titles in paragraphs is sloppy (incomplete or incorrect). Also, correct title for Reference III is, "... BOP Design and Development Plan."
   c) Use the up-to-date summary level WBS for Figure 2.1.

1.5 Section 3
   a) First sentence, program should be design plan here and elsewhere throughout text.
   b) Item 2, References III & V should be I, II, and III.

1.6 Section 4
   a) First sentence, "key outstanding" should be "priority technical."
   b) Item 3 should be generalized to include cross flow effects.

1.7 Section 4.1
a) First sentence should read, "... cannot complete a HTGR licensing review ..."

b) This section should end with a paragraph which summarizes what is planned.

1.8 Sections 4.3 and 4.4

These sections should also end with a summary paragraph that generally identifies what is planned.

1.9 Section 4.5

Relative to the other issues, this section provides far too much detail and seems out-of-balance. It is not clear that the Fission Product issue is necessarily a priority technical issue. What is the basis for including it as a priority issue in terms of major considerations, such as plant feasibility, licensibility, operability, or maintainability, and how do the results compare to the other priority technical issues. This should be the subject of separate correspondence.

2.0 Section 6.1, Plant Licensing

2.1 Status is generally well stated but should include specific references.

2.2 The planned program description (Section 6.1.4) has a comparably good correspondence with the logic network. Planning should, however, also be provided for the following:

a) LOP activities.

b) A near-term reference SAR, completion about June '83.

c) Maintaining the licensing assessment report current.

3.0 Section 6.2, Plant Safety and Investment Risk

3.1 Title of Section 6.2 differs from that given in Table of Contents.

3.2 Section 6.2.3, second paragraph; references should be quoted for the studies and LTR's indicated. Same comment applies to LTR in fourth paragraph.

4.0 Section 6.3, Plant Design and Interface

4.1 The subdivision of this section should be described.

4.2 Section 6.3.1.2

The objective of this task appears a little slim and is out-of-balance with others (see for example, 6.3.6.2).
4.3 Section 6.3.1.4

The use of NSS and NHS is used in various places; NSS is preferred and should be used throughout.

4.4 Section 6.3.2.2

The objective of this task should be broader.

4.5 Section 6.3.3

The BOPR is listed as the BORP throughout.

4.6 Section 6.3.5.2 and 6.3.5.4

The availability goal should be stated in a fashion that is compatible with the plant functional specification.

4.7 Section 6.3.5.4

Delete paragraph in middle of p. 6-23 which starts with, "The availability group will be responsible ..."

4.8 Section 6.3.7.3

In last sentence, mention is made of a Seismic Program Plan without any prior mention of what it is, what it is intended to be, etc. Is this part of the design plan?

5.0 Section 6.4, PCRV

-5.1 The breakdown of this section should be provided prior to section 6.4.1.

-5.2 In Section 6.4.1.3, phrase "reasonably-mature, partially-complete" seems to be contradictory.

6.0 Section 6.5, 6.6 & 6.7

6.1 The scope of these tasks should include performance verification activities prior to installation.

6.2 Suggest Section 6.5.2 be reworded to read "... to ensure operation of the core region neutron control and coolant flow control equipment within applicable functional and performance requirements." Similar modification should be made to Sections 6.6.2 and 6.7.2.

7.0 Section 6.8, Reactor Internals

7.1 The objective reads like the design is going to be based upon whatever the technology development plan happens to provide. The design plan should be providing the needs to the technology development plan.
7.2 In Section 6.8.4 (p. 6-58), mention is made of no graphite manufacturer of large blocks. Lack of a graphite source seems like a major obstacle. Additional information here should be provided on difficulty and likelihood of developing a source.

8.0 Section 6.9, Reactor Core Design

8.1 WBS element no. is XX18, not XX10.

8.2 Scope, either here or in Section 6.8, should also include the composite core mechanical performance. As a result of FSV performance and the subsequent identification of related high priority issues, at least the scope of the design plan should recognize the need for attention to the core assembly mechanical performance characteristics.

9.0 Section 6.10, Primary Coolant System Design

9.1 The subsections that this section is divided into should be described prior to Section 6.10.1.

9.2 The objective of Section 6.10.1.2 needs to be more specific.

9.3 In Section 6.10.2.2, a program plan is described rather than a set of objectives.

9.4 The scope and objective in Section 6.10.3 are intertwined. Some guidance needs to be provided for adequate statements. A proposed guide is as given by comment 12.1.

9.5 In Section 6.10.3, the plan to subcontract the design of the steam generator should be reflected.

9.6 The plan for verification testing of the steam generator design prior to fabrication should be described.

10.0 Section 6.1, Helium Service Systems

10.1 The breakdown of this section should be described prior to Section 6.11.1.

10.2 The phrase "reasonably-mature, partially complete," used in Section 6.11.1.3, seems contradictory.

11.0 Section 6.12

11.1 The breakdown of this section should be described prior to Section 6.12.1.

11.2 Typo in title of Section 6.12.1.

11.3 In Section 6.12.2.3, what phase of design has been completed?
11.4 Suggest second paragraph in Section 6.12.2.3 be reworded to read, "... being formulated, the conceptual design requirements of the auxiliary circulator are not well defined ..."

12.0 Section 6.13

12.1 The scope and objectives of the tasks in this section, and many other sections, are not stated appropriately. A suggested guideline is that "Scope" should be generally addressed to the system definition and function. Objective should be addressed to what is going to be done, like prepare detail design, fabricate, install, checkout, etc.

12.2 The overview activity described in Section 6.13.1 appears superfluous. More specific objectives are required.

12.3 Why are Sections 6.13.3 and 6.13.4 not combined?

12.4 The terminology "reasonably mature, partially complete" used in Section 6.13.4.3 appears somewhat contradictory.

III. Specific Network Reviews

The design plan review has been primarily focused on the text. Spot reviews of some of the networks have, however, been performed. Some specific comments from these spot reviews are being provided as being possibly representative.

A. PLANT DESIGN NETWORK SPECIFIC COMMENTS

1. Very large chunks of MH's are allotted to systems' integration work. Much of the effort appears to be redundant with other staff functions, QA, Technical Management or Project Management.

2. The MH's allotted to Performance Definition between 10/82 and 9/86 appears excessive.

3. The MH's provided for preparation of the preliminary POT's between 9/83 and 3/84 appear to be too much, too soon. Similar comment applies to the preliminary SUT's and POP's.

4. The availability assessment effort, particularly through 11/84, appears very large. Can this effort be justified?

5. 10,400 MH for a seismic review activity over a one year period, 9/86 to 9/87, seems excessive.

B. SYSTEM 12 NETWORK SPECIFIC COMMENTS

1. Excessive MH's appear to be estimated for the drawing preparation work. For example, why are 3480 MH required for production drawings after having
gone through a preliminary design (3000 MH), a prototype design phase (6540 MH), plus a prototype updating phase (7050 MH)?

2. There appears to be an excessive number of project management tasks like monitor cost estimate, prepare progress plans and reports, and monitor tests.

C. SYSTEM 21 NETWORK SPECIFIC COMMENTS

1. System Criteria & SDD

In view of general comment no. 5 above, the manhour allocations for developing generic criteria, such as lower plenum mixing, isolated loop performance flow stagnation, water ingress prevention (900 MH)*, PCRV drainage system, oil ingress (1222 MH), etc., look very high. (* plus 1440 MH for water detection criteria, plus 640 MH water removal criteria & design requirements?) Why are these on critical paths?

2. Steam Generator

a) The tens of thousands of manhours allocated for thermal and stress analysis are questioned for the conceptual and preliminary design stages for these reasons:

(1) By now, computer codes should have been developed to shorten the effort considerably in each stage, even for all new designs.

(2) These are apparently not all new designs (see General Comment no. 5).

(3) There are apparently too many iterations contemplated for these analyses.

b) Similar comments apply to SG component design (tube bundles, expansion loops, penetrations, shipping container, shrouds, etc.).

c) The Milestone Summary shows too many "0" slack items at this stage.

3. Motor and Controller

This is identified as critical path, somewhat surprising in view of work already completed.

D. SYSTEM 23 NETWORK SPECIFIC COMMENTS

1. Why is conceptual design a critical path item in view of all prior work?
2. Why is BOPR input also critical path?
3. Levels of effort for most tasks appear high. Does this represent more redesign?

E. SYSTEM 28 NETWORK SPECIFIC COMMENTS

1. Why are almost all design tasks indicated as critical path items when the Design Plan discusses similarity to 900 MW(e) HTGR-SC reference plant? (See General Comment no. 5).

2. CAHE water leak detection method and analysis should benefit not only from prior reference work but also from System 21 SG parallel effort. CAHE shroud design & analysis over 10,000 MH looks high.

3. Question 3840 manhour level of effort (2 manyears) for reliability analysis and 3840 MH for performance sensitivity analysis for CACS.

4. Auxiliary circulator tasks are apparently not too well defined as indicated by 300, 400, 500 MH rounded numbers for conceptual design subtasks, all on critical path.

5. Prototype design total of over 10,000 MH for auxiliary circulator, valve & motor, etc., looks high.