April 2, 1997 SECY-97-075

FOR: The Commissioners

FROM: L. Joseph Callan /s/
Executive Director for Operations

SUBJECT: METHODOLOGY AND CRITERIA FOR EVALUATING CORE RESEARCH CAPABILITIES

PURPOSE:

To obtain Commission approval of a proposed methodology and criteria for evaluating the need for core research capabilities, to include their size and composition.

SUMMARY:

In response to Direction Setting Issue No. 22, the Office of Nuclear Regulatory Research (RES) has developed a proposed methodology and criteria as a guide for determining:

- the areas of research where core capabilities are needed;
- the agency's regulatory functions that each core capability would support;
- the size of each core capability (FTE and contract support funds); and
- the skills and experimental facilities needed to maintain each core capability.

This paper explains the proposed methodology and criteria and provides the results of having applied the methodology and criteria to two areas of research. These two trial applications are provided to help in the understanding of this proposal.

BACKGROUND:

One of the general objectives of the draft NRC Strategic Plan is to "supply research needed to regulate effectively." The supporting strategy for accomplishing this objective states that

the NRC "will maintain a core

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research capability required now and in the future to support NRC's regulatory mission." This general objective and the supporting strategy are responsive to Direction Setting Issue (DSI) 22, "Research," in the Commission's Strategic Assessment and Rebaselining Initiative. The Commission's decision on DSI-22 states that the Office of Nuclear Regulatory Research (RES) "should develop criteria for determining core research capabilities for Commission approval" prior to applying the criteria to programmatic areas of research. RES has developed these criteria which are embedded in a methodology for a) assessing where core research capabilities will be needed in the foreseeable future and b) to determine their size and composition.

DISCUSSION:

The importance of identifying core research capabilities

NRC is a knowledge-based organization. The NRC Principles of Good Regulation state, in part, that "final decisions must be based on objective, unbiased assessments of all information..." and that "the highest technical and managerial competence is required and must be a constant agency goal." and that "regulatory decisions should be made without undue delay." and finally that "regulations should be based on the best available knowledge from research and operational experience." RES makes an important technical contribution to the agency's ability to live up to these principles. To have a high degree of assurance that it will be able to continue to do so in the future, RES must have access to expertise, data, analytical tools and/or experimental facilities (either on its staff or in contractor organizations) that can provide informed, timely and independent bases for making regulatory decisions.

Within this context, there are at least two fundamentally different ways to define a core research capability:

- First, one can define a core capability as a minimum cadre of experts and some experimental facilities that the agency would want to have available independent of any known or highly probable workload demands from the regulatory process. It would be an on-call capability that could respond in a limited, but knowledgeable, timely and independent manner. This is referred to in this paper as an "expertise driven core capability."

- Second, one can define a core capability more broadly to be a capability below which the agency cannot complete its "continuing, relatively steady state" regulatory work in a manner consistent with the principles of good regulation. This is referred to in this paper as a "workload driven core

capability." Peak and temporary workloads can influence the size of the RES budget, but they would not be considered in determining the size of a workload driven core capability. Using this definition, the size of a particular core capability would be determined by the amount and type of research that the staff believes will be needed on a continuing steady state basis over the foreseeable future. Using this definition, the agency could estimate what the NRC would need as a

research baseline to provide day-to-day technical support to its licensing organizations (user needs), as well as to conduct any needed long term anticipatory research. This core would represent an alarm level. Going below this alarm level would mean that the NRC's ability to regulate effectively had been degraded. Going below this level could be necessary under severe budget constraints, but at least it would be readily apparent that this would be the case.

The staff believes both definitions should be employed. The first definition would be operative when the regulatory demands on a particular area of research (over the foreseeable future) are determined to be minimal. The second definition would be operative when the regulatory demands on a particular area of research are determined to be sufficient to require a capability above the "expertise" level and these demands would be expected on a continuing basis for the foreseeable future. However, the expertise level included in a workload driven core capability would be separately identified.
Core capabilities would be revisited annually, so that appropriate adjustments could be made if earlier expectations proved to be incorrect. By maintaining a core capability, the NRC can be quite confident of having the baseline expertise needed to either address any known or potential issues or to provide a nucleus around which an expanded capability can be constructed in a timely and efficient manner. It will also provide RES management with a visible baseline of skills and experimental facilities, against which timely decisions can be made to sustain the core capability. Without this focus, essential expertise and facilities might be lost though attrition or other circumstances.

Coordination with others

In the course of developing the methodology/criteria proposed in this paper, RES held discussions with four different groups on our preliminary proposal. These groups were:

- directors of NRC user offices (NRR, NMSS, and AEOD);
- NRC program managers at DOE laboratories currently performing work for RES;
- deans of the nuclear engineering departments at six universities; and
- representatives from industry organizations (vendor groups, utilities, Electric Power Research Institute and Nuclear Energy Institute).

Based on the exchanges we had with these groups, the

methodology/criteria and the areas to be assessed were refined to reflect the current proposal.

Guiding principles

RES’s approach to evaluating the need for core research capabilities is based on the following guiding principles:

- Core capabilities will be determined using our current understanding of the regulatory environment and we will not speculate about the future. For example, we will not now assess core capabilities that might be needed to support: a) applications for early site permits, construction permits, or advanced design certifications beyond AP-600; b) regulation of DOE activities; and, c) applications for use of MOX fuels.

- NRR, NMSS and AEOD, as the primary users of research, will have a significant input into the need for core research capabilities by helping identify projected workloads. The assessment of core capabilities, to be done later this year, will be limited to user office participation. After Commission preliminary approval, a review by the NRC advisory committees, the Nuclear Safety Research Review Committee and NRC's external stakeholders would closely follow. Commission final approval would be sought after these reviews are completed and any changes are made to the core capability evaluations.

- There can be two types of core research capability. Expertise Driven: This would consist of a single skill or nucleus of skills, either on the RES staff or in contractor organizations or some combination of the two, and in some cases a limited experimental capability. It would represent a minimum capability to provide expert support to the regulatory process. Workload Driven: This is a core research capability that is engaged in research to meet the continuing and relatively steady state demands of the regulatory process, largely driven by user office needs. Attachment 1 contains a more detailed description of these two types of core capabilities and shows their relationship to the budget. A workload driven core capability would have the inherent ability to also perform the functions of an expertise driven core capability.

- Core capabilities will not have the capacity to perform unanticipated work unless some activities in the core program are deferred. Thus, such work will usually be performed using resources that are above core.
- Factors such as new legislation, new regulatory approaches, changes in technology, changes in the availability of contractor expertise/ facilities, operational events, or a perceived change in the continuing, relatively steady state demands from the regulatory process, could either point to the need for new core capabilities or indicate the need to change the scope and magnitude of existing core capabilities. Annual reassessments of core capabilities will be performed by RES in coordination with user offices to keep the core capability requirements from becoming

outdated.

- It is not practical to project core capability needs beyond the time horizon of NRC's Strategic Plan because of the considerable uncertainties associated with such long-range projections. This horizon is referred to in this paper as the foreseeable future.

- One cannot develop criteria that will determine the size of a core capability. These determinations must be based on judgment taking into

account past experience, the staff's best estimate about future continuing demands from the regulatory environment and/or the need for a minimum nucleus of skills and experimental facilities to support the regulatory process.

- RES will enter into cost-effective cooperative research programs with domestic and foreign organizations to obtain needed research and to maintain needed facilities.

- RES will ensure that NRC research does not unnecessarily duplicate industry programs and that NRC does not perform research that is properly the responsibility of industry. RES will take advantage of the research performed by industry, but will perform confirmatory research necessary to ensure the independence of NRC's technical positions.

- RES will consider the state of the existing technology/knowledge base when determining the need for core capabilities.

- RES will consider the regulatory alternatives, such as use of greater conservatism, to maintaining a core capability as one means of determining if a core is needed. In making this determination, it will be assumed that, if RES were to have no core capability, no other NRC office would have that capability.

- Core capabilities can provide both confirmatory and anticipatory research, as appropriate.

- "Non-research" functions currently within RES will not be assessed for core research capabilities. These are rulemaking activities and IPE/IPEEE reviews.

- RES staff that will support core capabilities (overhead) will not be included in the core capability resource estimates.

Approach

The approach used by RES to develop a methodology and criteria for assessing core research capabilities involves five sequential steps.

Step 1: Defining what would constitute a core research capability.

Step 2: Identifying the regulatory functions where support from a core research capability might be needed. These functions are:

- provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, events, materials uses, and license amendment requests;

- provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of

GSIs) stemming from new or evolving technologies and/or research results;

- develop, maintain, and apply analytical tools/databases -- maintain the NRC's institutional technical knowledge base;

- provide the technical bases for improvements to the regulatory framework (i.e., regulations, regulatory guides, codes and standards, new initiatives);

- improve the technical bases of regulation through involvement in research with domestic and foreign organizations; and,

- respond to oversight groups (Commission, Congress, public, ACRS, ACNW, NSRRC).

The definition of each of these functions is in Attachment 3.

Step 3: Developing criteria to indicate, in a qualitative sense, a) the amount of support that might be needed for each of the regulatory functions identified in Step 2, and b) the importance of that support to the regulatory mission of the agency. Fourteen criteria were developed. These criteria can be seen in Attachment 4, which is a core capabilities assessment form. This form requires a "high," "medium," "low," or "none" rating for each criterion and the rationale for each rating. "Low" and "none" ratings would indicate the need for either a small core or perhaps that no core capability is needed. "Medium" and "high" ratings would indicate the need for a more robust core capability. Metrics were developed (Attachment 5) to guide the assignment of "high," "medium," and "low" ratings to the 14 criteria on the core capability assessment form. These metrics were developed to define what is meant by each rating and to help ensure a reasonable degree of consistency among the ratings for all areas of research. It is recognized that there is a degree of judgment required in applying these metrics.

Step 4: Developing a way to document the resources needed for each core capability. Attachment 6 shows how these resources will be documented and cross referenced to the regulatory functions needing core capability support. The format distinguishes between in-house needs and those RES would expect to obtain from

contractors (expertise and experimental facility support.) The estimated cost of contractor support is also to be identified on the form. When all the areas of research have been assessed, RES will aggregate the results into a listing of in-house and contractor skills and experimental facilities that will need to be sustained as a core capability. RES will also sum up the contract support funds to identify a "core capabilities budget."

Step 5: Identifying all the areas of research that the staff believes need to be assessed for core capabilities. Attachment 7 shows the 39 areas of research that the staff plans to assess. If necessary, the number of areas that need to be assessed will be adjusted during the process of conducting the assessments.

Other supporting documentation

In the course of developing the above methodology/criteria, it became apparent that other relevant information would need to be addressed to do a thorough assessment. Attachment 8 shows the types of supporting information that will accompany each core capability evaluation.

Trial applications

Attachments 9 and 10 are the results of applying the methodology and criteria to two areas of research. These are provided to help in the understanding of this proposal. Attachment 9 addressing Hydrogen Distribution and Combustion, documents the need for an expertise driven core capability. Attachment 10 addressing Fuel Behavior, documents the need for a workload driven core capability.

Relationship of the core capability assessments to other taskings from the Commission/Chairman

There is a relationship between the core capability assessments that will be performed and three other assessments that have either been requested by the Chairman or are being contemplated as a part of the Commission's Strategic Assessment and Rebaselining Initiative (DSI No. 20, International Activities). These are:

- criteria for prioritizing RES contributions to international cooperative research activities
- sunsetting criteria that can be applied to determine when a research program should be brought to closure
- a systematic way to search for unanticipated or emerging safety issues so that RES does not a) prematurely terminate efforts or b) once terminated, fail to reconstitute them in a timely manner.

Prioritizing international efforts: RES plans to use the "high," "medium," "low" and "none" ratings for criteria 10, 11 and 12 on the core capabilities assessment form (Attachment 4) to determine the relative priority of each of its international cooperative research efforts. While these ratings are not numerically

weighted, RES believes that the criteria ratings, along with professional judgment, will permit a credible prioritized list to be developed. This list will be provided along with the core capability evaluations.

Program sunsetting (closure) criteria: Two definitions are necessary at the outset to have a common frame of reference to "programs" and "closure" points, as they are discussed within this paper. These definitions are:

- Program: A research area that is focused on a well defined issue and is a body of research that is narrow enough in scope to make the application of sunsetting criteria practical, i.e., the 39 areas of research listed in Attachment 7 are consistent this definition. They are not uniform in size, but they are well focused and issue oriented.

- Closure: The point at which the NRC decides to not fund any more work (in-house or elsewhere) or NRC decides to retain only an "expertise driven" core capability in a given research area. This expertise driven capability might include some limited research to respond to unanticipated issues or to attract and retain high caliber expertise or to have access to critical facilities that would otherwise not be readily available.

Both of these definitions are different from those used in the past. Sometimes, all the research conducted by the NRC has been referred to as the research "program". In other instances, broad areas of research such as Aging and Severe Accidents have been called research "programs". Moreover, smaller segments of research have been called programs, e.g., The Steam Generator "program" or the Human Factors "program" or the Fuel Behavior "program". Some of these programs are programs within programs. To have a common set of criteria for sunsetting that can be applied both practically and consistently, a more uniform and workable definition of "program" was deemed necessary. RES believes a workable level to apply sunsetting criteria is at the level defined by the 39 areas of research in Attachment 7.

Closure has traditionally been thought of as the point at which the agency concludes that all issues are resolved and does no more work. Actually, the question is more complex. The need for valuable core research capabilities (either in-house or elsewhere) is now being addressed. One important aspect of the current assessment is that of an "expertise driven" core capability. This is a capability that is small, but recognizes that there are many instances where you cannot eliminate all resources in a given area of research, even if the demands for research from user needs and/or exploratory research are either very low or non-existent. One has to ask: Has the program been sunset, if we still have expertise and may be conducting a small amount of research to sustain that expertise? RES believes that under these conditions the program has, for all practical

reasons, been sunset.

The NRC should not consider sunsetting programs only with respect to what has been accomplished, but also with respect to what, in the best judgment of the staff, will need to be accomplished. As proposed, the future assessments of core capabilities will provide a best judgment as to when the sunsetting point will be reached. This will be accomplished by annually applying the fourteen criteria in Attachment 4 and by considering the other supporting documentation

in Attachment 8. By doing so, a judgment will be made with respect to the level of program activity that will be needed to support the regulatory processes of the agency. All the relevant questions pertinent to sunsetting a program will be considered. These are:

- Is there a known or expected need, over the foreseeable future, for RES to provide the technical bases for agency decisions on a continuing number of safety or regulatory issues stemming from power plant operations, events, materials uses, and licensee amendment requests?

- Is there a known or expected need, over the foreseeable future, for RES to provide the technical bases for agency decisions on a continuing number of safety or regulatory issues stemming from new or evolving technologies and/or research results?

- Is there a known or expected need, over the foreseeable future, for RES to develop and maintain analytical tools and/or databases?

- Is there a known or expected need, over the foreseeable future, for RES to provide the technical bases for improvements to the regulatory framework? and

- Is there a known or expected need, over the foreseeable future, for RES to improve the technical bases for regulation through involvement in research with domestic and foreign organizations?

Creating a systematic way to search for unanticipated or emerging safety issues: RES believes that the annual core capability reassessments will provide this mechanism. Unanticipated or emerging safety issues can stem from four primary sources. These sources are:

- operational experience
- licensee initiatives
- changing technology
- new research results

These four sources are addressed in the first two functional areas on the core capability assessment form (Attachment 4). To be more systematic in our search for unanticipated or emerging safety issues, in the annual reassessment of core capabilities, RES will meet with NRR, NMSS, and AEOD to examine the prior

year’s assessment to see if there are any new developments in the four areas identified above that would warrant a change in research activities. While a new issue might not effect the core, it could justify the need for additional resources "above core." This annual reassessment would be in

addition to issues that would be identified on an on-going basis by either user offices or RES.

RECOMMENDATION:

That the Commission approve the recommended core capabilities methodology and criteria and provide the staff with sufficient time to apply this methodology to the 39 areas of research. RES believes that it will need six months following Commission approval of the methodology and criteria to complete the evaluations and coordinate them with NRR, NMSS and AEOD. Also, that RES be given the flexibility to make minor modifications to methodology and criteria if, during their application, it finds the need to do so. Any changes will be highlighted to the Commission in the paper forwarding the core capability assessments themselves.

COORDINATION:

The Office of the General Council has no legal objection to the proposed methodology and criteria.

The Office of the Chief Financial Officer has reviewed this paper and has no objection, but note that the Acting CFO believes that developing the "workload driven capability" is not necessarily needed to define a minimum core research capability.

L. Joseph Callan
Executive Director
for Operations

Attachments:
As stated

ATTACHMENT 1

TWO TYPES OF CORE RESEARCH CAPABILITIES
AND THEIR RELATIONSHIP TO "ABOVE CORE" NEEDS

	ABOVE CORE		RES staff, RES contractors and collaborative efforts to conduct research (analyses and experiments) to respond to peak/temporary workloads that cannot be accommodated by the core capability, e.g., ● some aspects of the AP-600 review ● some significant unanticipated requirements
BUDGET	CORE RESEARCH CAPABILITIES	WORKLOAD DRIVEN	Analyses and experiments conducted by RES staff, RES contractors and collaborative efforts to respond to a continuing, relatively steady state workload demand over the foreseeable future, which would be based largely on user needs. These demands could stem from: ● new regulatory approaches ● operational events, findings ● new technologies ● new issues ● license amendment requests ● new legislation ● new research
		EXPERTISE DRIVEN	RES staff provides expertise to: ● stay current with the state of the art--new and evolving nuclear related technologies, new research and other related developments and understand the safety and regulatory significance of this work. ● provide a level of expertise and interaction such that there is ready access to experts worldwide ● understand and maintain NRC's technical knowledge base and analytical tools ● provide a nucleus around which a larger capability can be built if needed ● provide an "on-call" resource to help respond to any technical issues that may arise. ● conduct or cooperate in joint research efforts of a limited nature in support of retaining expertise or access to facilities

ATTACHMENT 1

CORE RESEARCH CAPABILITY DEFINITION

RES has defined a core capability as a minimum resource that RES should maintain into the foreseeable future to support the regulatory mission of the agency.

A core capability can consist of either NRC staff, or NRC contractor staff, or the use of experimental facilities, or a mix of these capabilities. It is a resource that provides a credible technical base that is free from challenges of organizational bias. It also represents resources that cannot readily be acquired on an ad-hoc basis from non-NRC sources. It does not include work that can and should be performed by industry, but may include collaborative efforts with domestic and foreign organizations. It can perform both confirmatory and exploratory research, as warranted by the regulatory environment. It provides an adequate base to expand a program if the need arises, by being current in the field and knowing the experts worldwide. There are two types of core capability:

Expertise Driven: This is a resource, that would: stay current with the state of art (new and evolving nuclear related technologies, new research and other related developments) and understand the safety and regulatory significance of this work; provide a level of expertise and interaction such that there is ready access to experts worldwide; understand and maintain NRC's technical knowledge base and analytical tools; provide a nucleus around which a larger capability could be built, if needed; provide an "on-call" resource to help respond to unanticipated technical issues; and, conduct or cooperate in joint research efforts of a limited nature needed to retain needed expertise or to have access to facilities. This minimum capability is not based on workload. However, meaningful, challenging work is necessary to attract and retain high caliber expertise, both at the NRC and at contractor organizations. Core funding may also be needed to support work at critical or unique facilities, so those facilities are available when needed.

Workload Driven: This is a resource to conduct research in response to recurring demands from the regulatory process, largely from user needs, but it could also include exploratory research. The resource level is determined based on past experience and the staff's expectation of what would be continuing, relatively steady state workload demands for the foreseeable future. It is not based on temporary or peak workloads that currently exist nor does it anticipate any in the foreseeable future. Peak or temporary work would be accomplished with above core resources provided as part of the RES budget. The functions described above under "expertise driven," will also be performed within a "workload driven" core capability.

DEFINITIONS OF REGULATORY FUNCTIONS
THAT A CORE RESEARCH CAPABILITY MIGHT SUPPORT

1. Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, materials uses or license amendment requests:

   RES examines "off normal" conditions identified primarily through incidents, events and inspections, to understand their safety implications relative to prior, on-going and potential new areas of research. RES often provides the technical bases for resolving safety issues, including GSIs, associated with these conditions and licensee requests to amend their licenses. The frequency and significance of these conditions indicate the level of support that may be needed from a core research capability and its importance to the regulatory mission of the agency.

2. Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from new or evolving technologies and/or research results:

   RES is the NRC focal point for assessing new technology and its impact on NRC's regulatory posture. New technology can take the form of nuclear industry initiatives such as higher fuel burnups and the thermal annealing of RPVs. It can also be technology employed in other industries having relevance to nuclear safety. It can also take the form of new measurement/analytical techniques such as NDE of materials properties. NRC research results and the results produced by others are also evaluated for their safety or regulatory implications. The extent to which a) technologies evolve or are introduced, and b) new research results are produced, and the safety or regulatory significance of these changes, indicate the level of support that may be needed from a core research capability and its importance to the regulatory mission of the agency.

3. Develop, maintain, and apply analytical tools/databases--maintain institutional technical knowledge base:

   RES has a primary role in developing and maintaining the technical tools and databases used by the NRC to make highly technical regulatory decisions. RES also maintains a technical knowledge base for the NRC which allows past research results and ongoing work to be brought to bear on the regulatory decisions of the agency. How often these tools/data are used, the breadth of their application, their condition and their value to users indicate the level of support that may be needed from a core research capability and its importance to the regulatory mission of the agency.

4. Provide the technical bases for improvements to the regulatory framework (regulations, regulatory guides, codes and standards, new initiatives):

   RES conducts research to support improvements to regulations and regulatory guides. Research results and RES staff involvement with codes and standards setting bodies, also help improve the regulatory framework. RES also supports new regulatory initiatives, such as risk informed - performance based regulation. The nature and extent of the changes needed indicate the level of support that may be needed from a core research capability and its importance to the regulatory mission of the agency.

5. Improve the technical bases of regulation through involvement in research with domestic and foreign organizations:

   RES participates with others to conduct research in support of NRC's regulatory needs. Cooperative ventures reduce overall research costs. The level of NRC's commitment, the value of the contribution to the regulatory process and the magnitude of the resource savings to the NRC, indicate the level of support that may be needed from a core research capability and its importance to the regulatory mission of the agency.

6. Respond to oversight/advisory groups (Commission, Congress, public, ACRS, ACNW, NSRRC):

   RES responds to general information requests and technical inquiries pertaining to the resolution of safety issues and the content and focus of NRC's research program from various oversight/advisory groups. In some cases these inquiries result in the need to perform additional research. The frequency of these requests and their complexity/ significance indicate the level of support that may be needed from a core research capability and its importance to the regulatory mission of the agency.

ATTACHMENT 4

CORE CAPABILITY ASSESSMENT FORM

(CORE CAPABILITY AREA)

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
Provide the technical basis for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, events, materials uses or license amendment requests					
1. Frequency of occurrence					
2. Safety or regulatory significance, if they occur					
Provide the technical basis for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from new or evolving technologies and/or research results					
3. Likelihood of change					
4. Safety or regulatory significance, if they occur					
Develop, maintain, and apply analytical tools/databases -- maintain institutional technical knowledge base					
5. Breadth and frequency of application of tools/data					

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
6. Degree of improvement needed in tools/data					
7. Value of tools/data/knowledge base to the regulatory process					
Support improvements to regulatory framework (i.e., regulations, regulatory guides, codes and standards)					
8. Need to improve requirements and/or guidance					
9. Need to support new NRC regulatory initiative and/or approach					
Improve the technical basis of regulation through involvement in research with domestic and foreign organizations					
10. NRC's commitment					
11. Value of contribution to regulatory program					
12. Leverage factor for NRC resources					
Respond to oversight groups (Commission, Congress, public, ACRS, ACNW, NSRRC)					
13. Likelihood of occurrence					

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
14. Complexity and significance of subject matter					

ATTACHMENT 4

CORE CAPABILITY ASSESSMENT FORM

(CORE CAPABILITY AREA) ATTACHMENT 4

CORE CAPABILITY ASSESSMENT FORM

HYDROGEN DISTRIBUTION AND COMBUSTION

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, events, materials uses or license amendment requests					
1. Frequency of occurrence			X		New issues are not expected to arise since the likelihood of severe accidents is expected to be low.
2. Safety or regulatory significance, if they occur			X		It is not expected that fundamentally different issues would arise that would challenge our understanding of the distribution or combustion of hydrogen.
Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from new or evolving technologies and/or research results					

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
3. Likelihood of change			X		Research results from international research are expected to provide an improved understanding of issues involving hydrogen distribution and combustion, however, they are expected to produce only small to medium increases to our current knowledge.
4. Safety or regulatory significance, if they occur			X		Ongoing large scale tests are likely to raise little doubt about licensees being able to meet acceptable safety margins.
Develop, maintain, and apply analytical tools/databases -- maintain institutional technical knowledge base					
5. Breadth and frequency of application of tools/data			X		Tools are expected to be used only occasionally since issues involving hydrogen distribution and combustion occur infrequently.
6. Degree of improvement needed in tools/data		X			The ability to model issues of hydrogen distribution is limited, as is the validation of current assumptions of hydrogen combustion modes at high temperatures and at large scale.

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
7. Value of tools/data/knowledge base to the regulatory process		X			It is important that NRC be in a position to effectively evaluate issues which may arise from international research.
Support improvements to regulatory framework (i.e., regulations, regulatory guides, codes and standards)					
8. Need to improve requirements and/or guidance				X	Currently, there is no need to revise current regulatory requirements/guidance.
9. Need to support new NRC regulatory initiative and/or approach			X		Hydrogen distribution and combustion will have to be properly addressed in NRC's initiative to expand risk-informed, performance based regulation.
Improve the technical bases of regulation through involvement in research with domestic and foreign organizations					
10. NRC's commitment	X				The NRC is participating in two international cooperative research programs. The high temperature hydrogen combustion program being performed in cooperation with Japan is nearing completion. A cooperatively funded research program (with France and Germany) in Russia is ongoing.

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
11. Value of contribution to regulatory program		X			Participation in these international programs will provide information that will be useful in improving our understanding of various hydrogen combustion modes and provide access to additional research being performed by the international partners.
12. Leverage factor for NRC resources		X			NRC has funded approximately one half of the high temperature research program and is funding one third of the research program in Russia.
Respond to oversight groups (Commission, Congress, public, ACRS, ACNW, NSRRC)					
13. Likelihood of occurrence			X		Oversight review of this area is infrequent (once a year).
14. Complexity and significance of subject matter			X		Sufficient understanding of area exits to address significant issues in this area.

CORE CAPABILITY ASSESSMENT FORM

FUEL DESIGN AND BEHAVIOR

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, events, materials uses or license amendment requests					
1. Frequency of occurrence	X				Issues stemming from licensee amendment requests will continue to arise several times per year.
2. Safety or regulatory significance, if they occur	X				Issues related to the new designs, materials, and regimes of operation are likely to raise significant doubts about licensees ability to maintain acceptable safety margins.
Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from new or evolving technologies and/or research results					
3. Likelihood of change	X				Technologies related to new cladding materials are expected to keep evolving at a rapid pace both domestically and internationally to operate more economically.

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
4. Safety or regulatory significance, if they occur	X				The fuel damage criteria determine the continued coolability of the core after a postulated accident and the quantity of fission products released from the first barrier, the cladding.
Develop, maintain, and apply analytical tools/databases -- maintain institutional technical knowledge base					
5. Breadth and frequency of application of tools/data		X			FRAPCON is used by NRR for 3 or 4 analysis campaigns (multiple runs) per year in connection with licensing reviews. Continued use is expected to assess licensee amendment requests. FRAPTRAN and its precursor FRAP-T have been used rather extensively in the past year trying to understand in more detail the RIA tests performed in France, Japan, and Russia.
6. Degree of improvement needed in tools/data	X				Major deficiencies exist in existing tools in the areas of mechanical properties and cladding alloys at high burnup. Test results to assess fuel damage regulatory criteria are also not available for many fuel types and burnups.

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
7. Value of tools/data/knowledge base to the regulatory process	X				The improvements to existing tools are needed to give NRR the ability to effectively evaluate future licensee amendment requests, e.g., new fuel designs.
Support improvements to regulatory framework (i.e., regulations, regulatory guides, codes and standards)					
8. Need to improve requirements and/or guidance	X				Fuel damage criteria appear in many places in the regulations, regulatory guides, and the SRP. Recent experiments indicate that these criteria may not be adequate for review of new fuel designs and new cladding types.
9. Need to support new NRC regulatory initiative and/or approach				X	The current framework appears to be adequate, so no new approaches are needed.
Improve the technical bases of regulation through involvement in research with domestic and foreign organizations					

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
10. NRC's commitment	X				International agreements exist with France, Japan, Russia, and Norway; we are participating in activities in OECD; and we have one informal activity with Finland. We are currently negotiating MOUs with EPRI and DOE, and expect active participation from both in our experimental program.
11. Value of contribution to regulatory program	X				All four international agreements are providing test reactor data on high-burnup fuel. The Halden Project in Norway provides steady-state data for code development, while the others provide RIA data for revising regulatory criteria. Foreign programs have been our primary source of data.
12. Leverage factor for NRC resources	X				More than two thirds of our cooperative work with others is funded by others.
Respond to oversight groups (Commission, Congress, public, ACRS, ACNW, NSRRC)					

Regulatory support functions and 14 criteria that indicate the level of support that may be needed and the importance of that support	Rating				Rationale for each rating
	High	Med	Low	None	
13. Likelihood of occurrence	X				This area has received high visibility in the last couple years with several briefings from Commissioners, ACRS, and NSRRC. A full Commission briefing is scheduled for late March 1997, and ACRS has requested a subcommittee meeting shortly thereafter.
14. Complexity and significance of subject matter		X			The metallurgical and performance concepts involved are relatively easy to understand. However, the significance is rather high as the fuel damage limits distinguish between acceptable and unacceptable behavior (e.g., loss of coolable geometry) during transients and design-basis accidents.

METRICS

SUPPORT AREA NO. 1: PROVIDE THE TECHNICAL BASES FOR REGULATORY DECISIONS ON REGULATORY OR SAFETY ISSUES (INCLUDING THE RESOLUTION OF GSIs) STEMMING FROM POWER PLANT OPERATIONS, EVENTS, MATERIALS USES AND LICENSE AMENDMENT REQUESTS

Criterion No. 1: Frequency of occurrence:

HIGH - Issues stemming from power plant operations, events, materials uses and license amendment requests are expected to arise one or more times per year.

MEDIUM - Issues stemming from power plant operations, events, materials uses and license amendment requests are expected to arise in the foreseeable future, but at a frequency of less than HIGH (above).

LOW - Issues stemming from power plant operations, events, materials uses and license amendment requests are not expected to arise in the foreseeable future.

Criterion No. 2: Safety or regulatory significance if they occur:

HIGH - The issues stemming from power plant operations, events, materials uses and license amendment requests are likely to raise significant doubt regarding the ability of the licensee's safety measures, such as systems, structures, components, procedures, or programs to maintain acceptable safety margins (e.g., in preventing core damage, off-site release, morbidity, or mortality), or identifies a major gap in the scope of NRC's regulations or regulatory guidance.

MEDIUM - The issues stemming from power plant operations, events, materials uses and license amendment requests are likely to raise moderate doubt regarding the ability of the licensee's safety measures, such as systems, structures, components, procedures, or programs to maintain acceptable safety margins (e.g., in preventing core damage, off-site release, morbidity, or mortality), or identifies a moderate gap in the scope of NRC's regulations or regulatory guidance.

LOW - The issues stemming from power plant operations, events, materials uses and license amendment requests are likely to raise little doubt regarding the ability of the licensee's safety measures, such as systems, structures,

components, procedures, or programs to maintain acceptable safety margins (e.g., in preventing core damage, off-site release, morbidity, or mortality), or identifies a small gap in the scope of NRC's regulations or regulatory guidance.

SUPPORT AREA NO. 2: PROVIDE THE TECHNICAL BASES FOR REGULATORY DECISIONS ON REGULATORY OR SAFETY ISSUES (INCLUDING THE RESOLUTION OF GSIs) STEMMING FROM NEW OR EVOLVING TECHNOLOGIES AND/OR RESEARCH RESULTS

Criterion No. 3: Likelihood of change:

HIGH - The technology is evolving at a rapid rate and is expected to continue at that rate for the foreseeable future, or a significant amount of new results is expected from ongoing or planned research activities.

MEDIUM - The technology is evolving at a moderate rate and is expected to continue at that rate for the foreseeable future, or a moderate amount of new results is expected from ongoing or planned research activities.

LOW - The technology is evolving at a slow rate and is expected to continue at that rate for the foreseeable future, or a limited amount of new results is expected from ongoing or planned research activities.

Criterion No. 4: Safety or regulatory significance, if the change occurs:

HIGH - The new or evolving technologies and/or research results are likely to raise significant doubt regarding the ability of the licensee's safety measures, such as systems, structures, components, procedures, or programs to maintain acceptable safety margins (e.g., in preventing core damage, off-site release, morbidity, or mortality), or identify a major gap in the scope of NRC's regulations or regulatory guidance.

MEDIUM - The new or evolving technologies and/or research results are likely to raise moderate doubt regarding the ability of the licensee's safety measures, such as systems, structures, components, procedures, or programs to maintain acceptable safety margins (e.g., in preventing core damage, off-site release, morbidity, or mortality), or identify a moderate gap in the scope of NRC's regulations or regulatory guidance.

LOW - The new or evolving technologies and/or research results are likely to raise little doubt regarding the ability of the licensee's safety measures, such as systems, structures, components, procedures, or programs to maintain acceptable safety margins (e.g., in preventing core damage, off-site release, morbidity, or mortality), or identify a small gap in the scope of NRC's regulations or regulatory guidance.

SUPPORT AREA NO. 3: DEVELOP, MAINTAIN, AND APPLY ANALYTICAL TOOLS/DATABASES--MAINTAIN INSTITUTIONAL TECHNICAL KNOWLEDGE BASE

Criterion No. 5: Breadth and frequency of application of tools/databases:

HIGH - Tools/data are expected to be used many times each year and/or they apply to a wide range of applications; e.g., multiple reactor types, phenomena, issues, events.

MED - Tools/data are expected to be used several times each year and/or they apply to a few broad-based applications.

LOW - Tools/data are expected to be used only occasionally and/or they apply to a few narrowly focused applications.

Criterion No. 6: Degree of improvement needed in tools/databases:

HIGH - Major deficiencies exist in tools/data that will prevent their use in addressing expected safety or regulatory issues, or tools are highly inefficient to use.

MED - Deficiencies exist in tools/data that will detract from their usefulness in effectively addressing expected safety or regulatory issues, or tools are moderately inefficient to use.

LOW - Deficiencies exist in tools/data that should be corrected to optimize their value, but there are no significant deficiencies, or tools have minor inefficiencies that could be eliminated.

Criterion No. 7: Value of tools/databases/knowledge base to the regulatory process:

HIGH - Tools/databases/knowledge are expected to be highly effective and efficient in making significant safety or regulatory decisions with no reasonable alternative being available, and/or knowledge base is highly complex and limited to a single person or very limited number of people.

MED - Tools/databases/knowledge are expected to be effective on efficient in making safety or regulatory decisions and alternatives would be time consuming and costly, and/or knowledge base is relatively complex and

limited to a single person or very limited number of people.

LOW - Tools/databases/knowledge are expected to be useful in making safety or regulatory decisions, but there are other alternatives that could be employed at little additional cost, and/or knowledge base is common and rather widely understood.

SUPPORT AREA NO. 4: PROVIDE THE TECHNICAL BASES FOR IMPROVEMENTS TO REGULATORY FRAMEWORK (i.e., REGULATIONS, REGULATORY GUIDES, CODES AND STANDARDS, NEW INITIATIVES)

Criterion No. 8: Need to improve requirements and/or guidance:

HIGH - The regulatory improvement is needed for adequate safety; or it will have a significant impact on regulatory efficiency or regulatory flexibility for a majority of licensees or applicants in any category (i.e., there is a major gap in NRC's regulations).

MEDIUM - The regulatory improvement is needed as a safety enhancement; or it could have a significant impact on regulatory efficiency or regulatory flexibility for a significant number of licensees or applicants in any category.

LOW - The regulatory improvement could have an impact on regulatory efficiency or regulatory flexibility for a significant number of licensees or applicants in any category.

Criterion No. 9: Need to support new NRC regulatory initiative and/or approach:

HIGH - A significant contribution will be made to support a new NRC regulatory framework or approach such as risk-informed, performance-based regulation.

MEDIUM - A moderate contribution will be made to support a new NRC regulatory framework or approach such as risk-informed, performance-based regulation.

LOW - A small contribution will be made to support a new NRC regulatory framework or approach such as risk-informed, performance-based regulation.

SUPPORT AREA NO. 5: IMPROVE THE TECHNICAL BASES OF REGULATION THROUGH INVOLVEMENT IN RESEARCH WITH DOMESTIC AND FOREIGN ORGANIZATIONS

Criterion No. 10: NRC's commitment:

HIGH - There is or will be a formal agreement between the NRC and one or more organizations for cooperative research or the cooperative effort is a U.S. Government-mandated program or the cooperative effort is a major contributor to the regulatory program of another country.

MEDIUM - There is no formal agreement, but NRC maintains ongoing participation in research-related activities with organizations such as DOE, EPRI, IAEA, and NEA.

LOW - There is no formal agreement, but NRC participates in research- related activities on an ad hoc basis.

Criterion No. 11: Value of contribution to regulatory programs:

HIGH - The results from cooperative programs directly support resolution of safety or regulatory issues and are not otherwise available, or the cooperative program is vital for NRC to sustain a core research capability.

MEDIUM - The results from cooperative programs provide information immediately useful for code assessment, confirmatory information, or expanded databases, but are not essential to resolution of safety or regulatory issues.

LOW - The results from cooperative programs help maintain awareness and have potential for use over the long term.

Criterion No. 12: Leverage factor for NRC resources:

HIGH - 67% or more of the work on cooperative efforts is done by or paid for by others.

MEDIUM - 33-66% of the work on cooperative efforts is done by or paid for by others.

LOW - Less than one-third of the work on cooperative efforts is done by or paid

for by others.

SUPPORT AREAS NO.6: RESPOND TO OVERSIGHT GROUPS (COMMISSION, CONGRESS, PUBLIC, ACRS, ACNW, NSRRC)

Criterion No. 13: Likelihood of occurrence:

HIGH - The subject matter is sufficiently important to oversight groups that future requests for status reports or insights are expected to occur several times a year, as results are available.

MEDIUM - The subject matter is of moderate interest or the pace of new developments is such that oversight groups are likely to request status reports or insights about twice a year.

LOW - The subject matter is usually addressed on an annual frequency (or less often), which suggests that the issue does not require immediate resolution, the technical progress is slow due to the complexity of the problem, and/or it is a recurrent topic.

Criterion No. 14: Complexity and significance of subject matter:

HIGH - The oversight groups need to be in the position to give guidance and direction in this area and to incorporate current findings into policy decisions. It is a national or international issue of high regulatory or safety significance that requires prompt action. This would be the case in an abnormal incident involving potential significant risk to the public or in the resolution of a complex design issue relating to a license application.

MEDIUM - Technical issues under consideration are those in which there are diverse opinions regarding the means to resolve differences among the licensee, staff, or interested technical community. These differences may arise from lack of data or technical knowledge from conflicting data and opinions, or from several alternative approaches to address the perceived issue.

LOW - Technical issues are reasonably well understood and the path to their resolution is relatively straightforward and agreed upon.

ATTACHMENT 6

(Core Capability Area)
CORE CAPABILITY RESOURCES

TYPE OF EXPERTISE NEEDED	FTE		CONTRACTOR SUPPORT ($K)
	STAFF	CONTRACTOR	
*			
*			
*			
TYPE OF FACILITY SUPPORT NEEDED			
*			
TOTALS			

RATIONALE

Staff FTE --

Contractor Support --

IMPLICATIONS OF HAVING ONLY A CORE CAPABILITY OR NO CORE CAPABILITY

REGULATORY FUNCTIONS*

1. Provide technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, events, materials uses, and license amendment requests.
2. Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from new or evolving technologies and/or research results
3. Develop, maintain, and apply analytical tools/databases -- maintain institutional technical knowledge base
4. Provide the technical bases for improvements to regulatory framework (i.e., regulations, regulatory guides, codes and standards)
5. Improve the technical bases of regulation through involvement

ATTACHMENT 6

in research with domestic and foreign organizations

6. Respond to oversight groups (Commission, Congress, public, ACRS, ACNW, NSRRC)

THIRTY-NINE AREAS OF RESEARCH WHERE THE NEED FOR CORE CAPABILITIES WILL BE ASSESSED

Thermal Hydraulics

1. Plant Transient Analysis
2. Code Development, Validation, and Maintenance

Reactor Physics

3. Core Transient Analysis
4. Code Development, Validation, and Maintenance

5. **Fuel Design and Behavior**

Advanced Instrumentation and Controls

6. Digital I&C Systems Performance
7. Software and Hardware Reliability and Qualification

Human Factors and Organizational Performance

8. Human Reliability
9. Training, Staffing, and Qualifications
10. Human-System Interface and Procedures
11. Organizational Performance

12. **Fire Protection and Safety**

Reactor Vessel Integrity

13. Radiation Damage/Annealing
14. NDE Procedures and Techniques
15. Fracture Mechanics

16. **Environmentally Assisted Cracking**

17. **Structural Integrity**

18. **Behavior of Structures and Components in Response to Seismic and External Events**

19. **Steam Generator Integrity**

Mechanical/Electrical Components and Piping

20. Mechanical
21. Electrical
22. Piping

Severe Accident Risk

23. Fuel-Coolant Interactions
24. Core Degradation
25. Core Concrete Interaction and Debris Coolability
26. Hydrogen Distribution and Combustion
27. Lower Head Integrity
28. Fission Product Chemistry, Release and Transport
29. Code Development, Validation, and Maintenance

Probabilistic Risk/Safety Analysis

30. Methods Development for Assessment
31. Regulatory Analyses
32. Guidance and Standards Development
33. Decision-making Under Uncertainty

Radiation Protection

34. Radiation Dosimetry
35. Radiation Effects (relationship between dose and risk)

36. **Fuel Fabrication**

37. **Radionuclide Transport and Behavior in the Environment**

Spent Fuel

38. Storage
39. Decommissioning and Decontamination

ATTACHMENT 6

ATTACHMENT 8

SUPPORTING DOCUMENTATION

What is the research area defined to include?

What assumptions were made when making the core capability assessment?

What is the status of the technology/knowledge base in this area?

What are the different disciplines that need to be supported? Which of these disciplines should be at NRC and which should be at contractor organizations? Which would disappear if not supported by the NRC?

What facilities are needed, if any. Why should they be supported? Will they be used frequently enough to justify their expense? If the facility was abandoned, would the cost to reassemble or construct a new facility, if needed, be prohibitive?

What portion of the core capability, if any, can be obtained from other than NRC funded sources? Can it be obtained in a timely manner and with independence?

If this area were at the core level today, what work could not be performed?

What is the regulatory alternative, if there was no core capability in this research area?

HYDROGEN DISTRIBUTION AND COMBUSTION

Definition of research area:

This research addresses issues involving experimental data and methods related to hydrogen distribution and combustion following severe accidents. The deflagration of hydrogen is one of the primary challenges to containment integrity and equipment survivability following a severe accident.

Assumptions made when assessing the need for a core capability:

The likelihood of a severe accident is low and ongoing international research in this area will not raise significant new issues involving hydrogen combustion challenges to containment integrity.

State of the technology/knowledge:

The state of knowledge of hydrogen distribution and combustion has been sufficient to resolve the significant safety issues. However, some issues remain related to a better understanding of scaling and the likelihood of occurrence of various modes of combustion at high temperature in the presence of large quantities of steam.

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FUEL DESIGN AND BEHAVIOR

Definition of research core area:

A number of fuel damage criteria are used as operating limits in plant and core-reload licensing. The adequacy of these criteria, and the ability to calculate fuel behavior in relation to these criteria, must be reestablished from time to time as new fuel designs, materials, and new operating regimes are introduced to ensure that the underlying safety objectives are satisfied. Experimental work is performed to provide the basis for these criteria, for understanding related performance phenomena, and for modeling. Two fuel behavior codes are maintained for fuel rod analysis: FRAPCON (steady state) and FRAPTRAN (transient).

Assumptions made when assessing the need for a core capability:

It is assumed that new fuel designs will continue to be introduced as cladding alloys are refined and that longer operating cycles and higher burnups will be sought to improve operating economics.

State of the technology/knowledge:

A basic understanding of the behavior of oxide fuel and metal cladding, along with analytical modeling, is well developed. However, much of the quantitative description is empirical, and large extrapolations have not worked well. Particularly at high burnup, there are new phenomena and limitations on available data, especially under transient conditions related to safety.

ATTACHMENT 6

FUEL DESIGN AND BEHAVIOR

What portion of the core capability, if any, can be obtained from other than NRC funded sources, and if so, can it be obtained in a timely manner and with independence?

There is no practical non-NRC source for fuel rod analysis (codes). All such codes in the U.S. have been developed by the vendors or EPRI. They are proprietary and would not give NRC a capability that is independent of the regulated industry. A few foreign government codes might be made available, but they are generally not open for public scrutiny. Experimental data needed for code development and regulatory criteria can be obtained, in part, from foreign government programs for a price. In general, safety-related research (i.e., investigations of transients and accidents) is not performed by the industry, so data available from industry sources would be limited to basic steady-state information.

What are the different disciplines that need to be supported? Which of these disciplines should be at NRC and which should be at contractor organizations? Which would disappear if not supported by the NRC?

Two different disciplines are needed: (1) materials science, covering zirconium metallurgy, ceramic engineering, and including experimental procedures and (2) analytical modeling, including code running skills. Some of each is required at NRC to define needed work and apply the results. Experimental programs require the use of contractors. In principle, the analytical work could be done entirely at NRC; however the present contractor arrangement provides a larger group of skilled personnel. While international efforts in this area would likely continue; domestically, the materials science discipline, as applied to transients and accidents would be diminished without NRC support. The analytical modeling discipline would be maintained by the industry, which we regulate, but NRC’s independent capability would be lost if not supported by the NRC.

What facilities are needed, in any? Why should they be supported? Will they be used frequently enough to justify their expense? If the facility was abandoned, would the cost to reassemble or construct the facility, if needed, be prohibitive?

Provided that major foreign programs continue to operate key test reactors and cooperate with the NRC, we can probably meet our needs by maintaining the good analytical hot cells at ANL. In these cells, we can examine irradiated fuel from U.S. power reactors, measure cladding properties, and simulate some transients and accidents.

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ATTACHMENT 6

HYDROGEN DISTRIBUTION AND COMBUSTION

What portion of the core capability, if any, can be obtained from other than NRC funded sources, and if so, can it be obtained in a timely manner and with independence?

General expertise in the area of hydrogen combustion can be obtained from experts outside of the NRC. However, NRC's work requires an understanding of the distribution and combustion of hydrogen in a severe accident. In this context, the ability to obtain needed expertise in a timely manner is limited.

What are the different disciplines that need to be supported? Which of these disciplines should be at NRC and which should be at contractor organizations? Which would disappear if not supported by the NRC?

NRC should retain familiarity with distribution and combustion of hydrogen during severe accidents and obtain detailed combustion expertise from a contractor.

The specific combustion discipline would not disappear, or become completely unavailable, if not supported by NRC. However, without a core capability, the level of staff expertise would necessarily become limited, to the point that the ability to be aware of and respond to issues would be compromised.

What facilities are needed, if any? Why should they be supported? Will they be used frequently enough to justify their expense? If the facility was abandoned, would the cost to reassemble or construct the facility, if needed, be prohibitive?

There are no unique facilities that are essential to this core capability. Large-scale testing facilities, currently available through cooperative programs, are providing important insights for our understanding of scaling effects and should be continued. Support of a small scale combustion facility, at small cost, is required to sustain contractor expertise to support RES needs.

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HYDROGEN DISTRIBUTION AND COMBUSTION
CORE CAPABILITY RESOURCES

TYPE OF EXPERTISE NEEDED	FTE		CONTRACTOR SUPPORT ($K)
	STAFF	CONTRACTOR	
Combustion (1, 2, 3, 5, 6)*	1.0	0.1	25
TYPE OF FACILITY SUPPORT NEEDED			
Small Scale Combustion (3)*		0.5	125
TOTALS	1.0	0.6	150

RATIONALE

Staff FTE -- RES would maintain a small in-house capability to: 1) support improvements in analytical tools; 2) follow international and domestic research performance by others; 3) maintain the institutional technical knowledge base, and 4) be available to respond to issues that may arise from regulatory actions or from other sources.

Contractor Support -- RES should sustain a small amount of contract support to: 1) support improvements in the analytical capabilities and database; 2) support international and domestic research performance by others; and 3) maintain access to world class expertise that would help NRC respond to future issues that may arise.

IMPLICATIONS OF HAVING ONLY A CORE CAPABILITY OR NO CORE CAPABILITY

If this area was at the core level today, what current work would not be done?

Work on high temperature hydrogen combustion could not be performed and research on large scale hydrogen combustion in steam environments would not
be conducted. The ongoing work on testing passive autocatalytic recombiners (PARs) in support of the AP-600 design would not be performed.

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Regulatory alternative if there was no core research capability:

The NRC would have to rely on outside expertise if any new issues were identified. This expertise, although generally familiar with the issues of hydrogen combustion, is usually not familiar with the issues involving the distribution and combustion of hydrogen in severe accidents.

REGULATORY FUNCTIONS*

1. Provide technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, events, materials uses, and license amendment requests.
2. Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from new or evolving technologies and/or research results
3. Develop, maintain, and apply analytical tools/databases -- maintain institutional technical knowledge base
4. Provide the technical bases for improvements to regulatory framework (i.e., regulations, regulatory guides, codes and standards)
5. Improve the technical bases of regulation through involvement in research with domestic and foreign organizations
6. Respond to oversight groups (Commission, Congress, public, ACRS, ACNW, NSRRC)

CORE CAPABILITY RESOURCES
FUEL DESIGN AND BEHAVIOR

TYPE OF EXPERTISE NEEDED	FTE		CONTRACTOR SUPPORT ($K)
	STAFF	CONTRACTOR	
Materials Science (1-7)*	1.0	2.0	500
Analytical Modeling (1-7)*	1.0	2.0	450
TYPE OF FACILITY SUPPORT NEEDED			
Analytical Hot Cells (5)[1]		2.0	1,000
TOTALS	2.0	6.0	1,950

[1] Excluding cost of participation in foreign program.

RATIONALE

Staff FTE -- Experience has shown that it takes 1 FTE to manage the contracts and perform in-house code calculations, and it takes 1 FTE to keep up with 4 foreign agreements, planning of experiments, and assessment of experimental results. While more rapid progress could be made with more FTEs, a reduction blow 2 FTEs would result in the dropping of important activities like the in-house analysis capability.

Contractor Support -- We estimate that it takes a minimum of $1M (about 4 FTE equivalents) to sustain a hot-cell program that includes salaries for trained operators of remote manipulators, construction of test equipment, design of test procedures, and analysis of results. This assumes that other sources of funds are available to share support of basic hot-cell requirements like health physics, maintenance, and safety. The analysis budget of $450K supports 2 FTE modeler/code-developers. A single FTE working in isolation would not be effective.

IMPLICATIONS OF HAVING ONLY A CORE CAPABILITY OR NO CORE CAPABILITY

If this area was at the core level today, what current work would

not be done?

This research area is at its core level today.

Regulatory alternative if there was no core research capability:

Traditionally, NRC has developed its own fuel damage regulatory criteria based on its own research. Absent an experimental program, staff would have to rely on largely conservative criteria to make licensing decisions e.g., decisions related to new designs for high burnup fuel. Without the ability to develop analytical models and to perform calculations for accident analyses, the NRC would lose most of its technical capability, and thus its independence in this area.

REGULATORY FUNCTIONS*

1. Provide technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from power plant operations, events, materials uses, and license amendment requests.
2. Provide the technical bases for agency decisions on regulatory or safety issues (including the resolution of GSIs) stemming from new or evolving technologies and/or research results
3. Develop, maintain, and apply analytical tools/databases -- maintain institutional technical knowledge base
4. Provide the technical bases for improvements to regulatory framework (i.e., regulations, regulatory guides, codes and standards)
5. Improve the technical bases of regulation through involvement in research with domestic and foreign organizations
6. Respond to oversight groups (Commission, Congress, public, ACRS, ACNW, NSRRC)