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Management Structure and Safety Issues Related to the Neely Nuclear Research Reactor and the Radiation Safety Program at Georgia Tech

Report Prepared by

Nicholas Tsoulfanidis, Ph. D., P.E.

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Summary and Recommendations

1. There are no safety issues relative to the operation of the reactor at NNRC; the current Director is very safety conscious. With the nuclear fuel gone, the safety issue is non-existent.

2. With the new LEU fuel installed, a review of all components of the reactor for possible replacement or maintenance, should be performed.

3. The ^{60}Co source creates a negligible risk to either the personnel at NNRC or any person outside the facility.

4. The Nuclear Safeguards Committee operates effectively and its membership is quite appropriate; minutes of the Committee should be expanded, somewhat, to include the major points of the discussion of every issue.

5. Minutes of the NSC should be circulated to the staff immediately after they are ready and should be discussed in a meeting. This discussion of the Committee actions is particularly important if new procedures or policies are instituted.

6. The Director of the NNRC and the Radiation Safety Officer should report to two different administrators; two different budgets should be established.

Assignment: The assignment was to investigate the management structure of the Neely Nuclear Research Center (NNRC), giving particular emphasis to safety matters.

I visited the GA Tech (GT) campus and spent three days (Dec. 18-20, 95). I interviewed the following people:

Dr. Ratib Karam, NNRC Director
Mr. Dixon Parker, Reactor Supervisor
Mr. Edgar Jawdeh, Health Physicist
Dr. Rodney Ice, Manager Office of Radiation Safety (MORS)
Mr. Billy Statham, Sr. Reactor Operator
Dr. Gary Poehlein, Professor of Chemical Engineering, Former VP for Interdisciplinary Programs
Mr. E. Cobb, Chair of NSC; telephone interview.

From the GT administration, I talked to Dean John White and Associate Dean J. Narl Davidson, and to Dr. Jean-Lou A. Chameau, Vice Provost for Research; in an exit interview, I talked with Mr. Randy Nordin, Mr. Gary Wolovick, and Ms. Pat Guilday.

Questions asked: Before I asked any questions I made it clear to the person being interviewed that the conversation is confidential and is protected by a relationship similar to attorney-client. Common questions I asked individuals directly associated with NNRC are:

1. Are the minutes of the Nuclear Safeguards Committee (NSC) shared or discussed with you ?

2. Are NRC inspection reports discussed with you? with the NSC?

3. To your knowledge, are all incidents at NNRC reported to the NSC and recorded in the minutes?

4. The 1987 contamination incident seems to be the result of a combination of procedure-related events (procedures not well written, not well understood, not well followed etc). Has this situation improved since then? Could such an incident happen again?

5. You are about ready to ship out the fuel. Are the relevant procedures ready? Do you feel that you are ready for this operation?

6. Is there an established process for operating procedures addition, modification, or elimination?

The answers to these questions (based also on the files and records I checked; see next section) are all yes . In question # 4, the answer to the question about the contamination incident happening again is: It is highly unlikely.

Records checked:

1. Minutes of the NSC since 1987
2. Procedures (I did not check every individual procedure; instead, I concentrated on the question: is there an area not covered?)
3. Annual audits of the program
4. NRC inspections
5. GANE concerns and NRC and GT response.
6. Safety Analysis Report for NNRC
7. NNRC Emergency Preparedness Plan
8. Radiation Safety manual

Safety Issues:

The primary safety concern is potential unnecessary radiation exposure of (a) the NNRC personnel, and (b) the public that may result from activities and operations taking place at the NNRC. After completing all the interviews and checking all the documents, I found no evidence that the GT Administration and the public should be concerned about safety matters from the activities taking place at NNRC. This statement about safety is based on what I learned about the Director's attitude towards safety and the structure of the Radiation Safety Program. Here are specific comments.

1. I have found or heard no evidence against the safety consciousness of Dr. Karam; on the contrary there was one comment made that he is so safety-occupied that some activities may be hindered.

2. The NSC has excellent membership; it is an outstanding feature that some members are not GT employees (the present Chair is not a GT employee also). The NSC meets as frequently as required. Every year all the NSC members participate in the annual audit of the program, an audit that includes a review of all the procedures. Excellent practice!

If I have one criticism concerning the NSC is the minutes of the meetings. The minutes are so compact that it is difficult to understand the item discussed and impossible to see the logic behind a decision, since none of the discussion is included in the minutes. I realize that the minutes of any meeting should not include all that was said, but it is not right to include only titles of items discussed and the decision made.

3. NRC inspections resulted in violations, many times. This is unfortunate, but the important fact is that no violation had to do with overexposure or even exposure of any significance of staff or the public; also, none of the violations were the result of unsafe operation of the reactor. The most serious violation was the errors discovered in a report that recorded releases of radioactivity to the environment. This matter was discussed by the NSC and the response of the University satisfied the NRC. The discrepancies of release rates were the result of sloppy arithmetic; it was not an attempt to hide unlawful activities and the important piece of information for this matter is that the releases were far below the NRC allowed limits.

4. The reactor at NNRC is a safe machine with inherent safety features, i.e. safety features that depend on physical laws. It offers research possibilities as a source of neutrons and gammas. Potential research would include the use of the medical room, for neutron irradiation (some effort is already underway involving GT and Emory University), the use of the cobalt source, to study effects of gammas on sterilization of food, instruments etc and also effects on such reactor components as cables, seals, and other materials whose performance may be affected by high gamma doses over a long period of time.

In the nuclear industry, the effort to extend the life of existing nuclear power plants will increase; in order for the NRC to extend a license, all safety questions have to be answered; granted, the main concern is the integrity of the pressure vessel, but all components must operate reliably; if not, the capacity factor (which determines the electricity produced and sold) will decrease and will make the nuclear plant less economical. Thus, there is definitely going to be increased research activity in the area of neutron and gamma radiation effects and the NNRC has the capability to provide the required radiation source for such research.

Even when the fuel is in the core and the reactor is operating, the facility has been and will continue to present negligible risk to students, faculty, and staff of GT and, of course, to the public. When the fuel is removed, the risk is essentially zero. The only potential risk at NNRC after the HEU fuel is removed and before the new LEU fuel is installed in the core, is the ^{60}Co source.

Risk from ^{60}Co source.

The NNRC has about 250,000 Ci of ^{60}Co in a pool of water. The source is solid, encapsulated in metal, and cobalt, it should be mentioned, is insoluble in water. The only incident that one might think to happen, which is extremely unlikely, is the loss of water in the pool. If the water is lost, the question arises what is the dose rate at the outside wall of the building housing the source? The dose rate inside the building should not raise any concerns because that is an area controlled by the NNRC staff.

I performed a calculation, using very conservative assumptions, of the dose rate at the outside of the wall of the building, at a point where the highest dose rate would be expected (point A, see sketch). With the water gone, radiation shielding is provided by the wall of the pool, the soil between the pool and the wall, and the building wall itself. I made the following assumptions.

(i) The source is located at the center at the bottom of the pool.
(ii) I neglected any self-absorption in the source and attenuation by the air.
(iii) I assumed all the shielding material to be soil (dirt) with density 1.5 g/cm^3, i.e. I considered the concrete walls to have that density as well (true concrete density is at least 2.35 g/cm^3).
(iv) I considered the gamma-ray buildup (from scattering of gammas in the attenuating medium).
(v) I considered 'skyshine' radiation, i.e. gammas that hit the ceiling of the building and are scattered back towards the point of interest. I made the very conservative assumption that 3% of the gammas hitting the ceiling are reflected back towards the outside wall.

The result of the calculation is:

Direct dose rate is about 3×10^{-8} mrem/h
Dose rate from skyshine is about 6×10^{-5} mrem/h

It should be mentioned that the background radiation level should be about 0.01 to 0.03 mrem/h (excluding radon). Thus, even under the most conservative assumptions, with the loss of water in the pool, a person could standing close to the outside wall would receive less than 1% of the background radiation that exists everywhere and is received by every person anywhere.

Based on this calculation, I do not consider it necessary to have the already existing fence around the NNRC replaced or reinforced ; a new fence would just attract attention and raise questions without increasing safety.

Recommendations for changes.

1. The NNRC Director does not discuss routinely the minutes of the NSC, with his staff, after each meeting (the MORS does it, however). As a result, procedures that have been modified or approved by the NSC may not be known to the Reactor staff immediately. A couple of violations found by the NRC occurred because of miscommunication or no communication of changes approved by the NSC and not known by the staff.

The minutes of every NSC meeting should be circulated among the staff, as soon as they become available, and should be discussed in a meeting; the discussion is particularly important if new procedures or policies are instituted.

2. The minutes of the NSC should be expanded somewhat to include part of the discussion taking place. I see two advantages if this change is implemented. One, the staff will understand better the operation and decision-making process of the NSC. Two, at later times it will be easier to remember why a decision was made. A minor advantage of such change may be a better understanding by NRC inspectors as to how the NSC operates. Of course, the proposed change requires better writing and editing by the secretary of the committee.

3. The safety analysis report for the LEU fuel has been approved by the NRC. However, I have not seen any report by the reactor staff or any report requested by the Administration about replacing or upgrading reactor components other than the fuel. It will be unfortunate if the LEU fuel is installed and the operation of the facility is limited by items like malfunctioning pumps, heat exchangers, instrumentation etc.

4. The reactor of the NNRC is under-utilized by the GT faculty. I had neither the time nor the assignment to find out why. I believe, however, that the administration should try to find the answer by asking the faculty what they think about the potential uses of the NNRC. The investigation should not be restricted to the Nuclear Engineering/ Health Physics professors. Other faculty in Chemistry, Physics, Biology etc may use the reactor or the ^{60}Co source.

5. The present administrative structure of the Radiation Safety Program seems to work fine and there is no evidence of any kind that safety is compromised. Thus, there is no need to replace the current Director. However, the present reporting method has the potential for errors , omissions, and abuse, particularly if the current Director is replaced and the new one is not so safety-conscious.

To be specific, at present the NNRC Director is also the RSO for the campus. Everybody else reports to him, including the MORS. The Director controls the agenda of the NSC; the director controls all budgets, including that of Health Physics activities. There is no evidence that the current Director either made mistakes or abused the system. However, whenever a program or activity is controlled by a single person the possibility of error or omission of action is possible. For this reason I recommend that the institution change the administrative structure in the following way (see also diagram).

The NNRC Director should report to the Dean of Engineering or equivalent.

The Radiation Safety Officer (or MORS) should report to the Vice Provost for research or equivalent. It is important that the NNRC Director and RSO report to two different persons.

Separate budgets should be set up for the Director of the Reactor and for the RSO.

The RSO will be responsible for Health Physics coverage for the GT campus; the Director of NNRC will be responsible for the safe operation of NNRC and will get Health Physics coverage from the RSO. Both the Director and RSO,

a. are non-voting members of the NSC; they should be allowed to send their designated representative to a meeting if they themselves cannot be present,

b. report to the NSC and both contribute to the agenda of the NSC meetings,

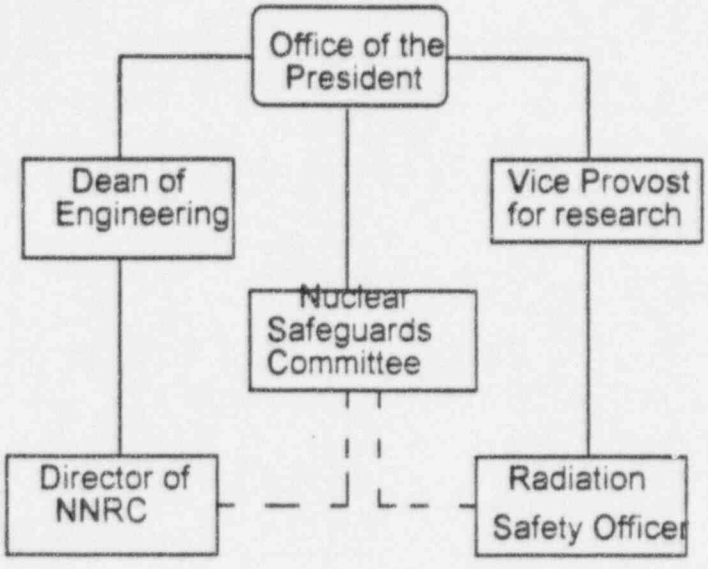
c. in case of differences of opinion between the Director and RSO, differences that are not covered by existing operating procedures, the NSC will resolve the issue.

6. The present structure and method of appointment of the NSC membership are excellent and should continue.

Acronyms used

GANE	Georgians Against Nuclear Energy
GT	Georgia Tech
HEU	Highly Enriched Uranium
LEU	Low Enriched Uranium
MORS	Manager Office of Radiation Safety
NNRC	Neely Nuclear Research Center
NRC	Nuclear Regulatory Commission
NSC	Nuclear Safeguards Committee
RSO	Radiation Safety Officer

Proposed Administrative Structure



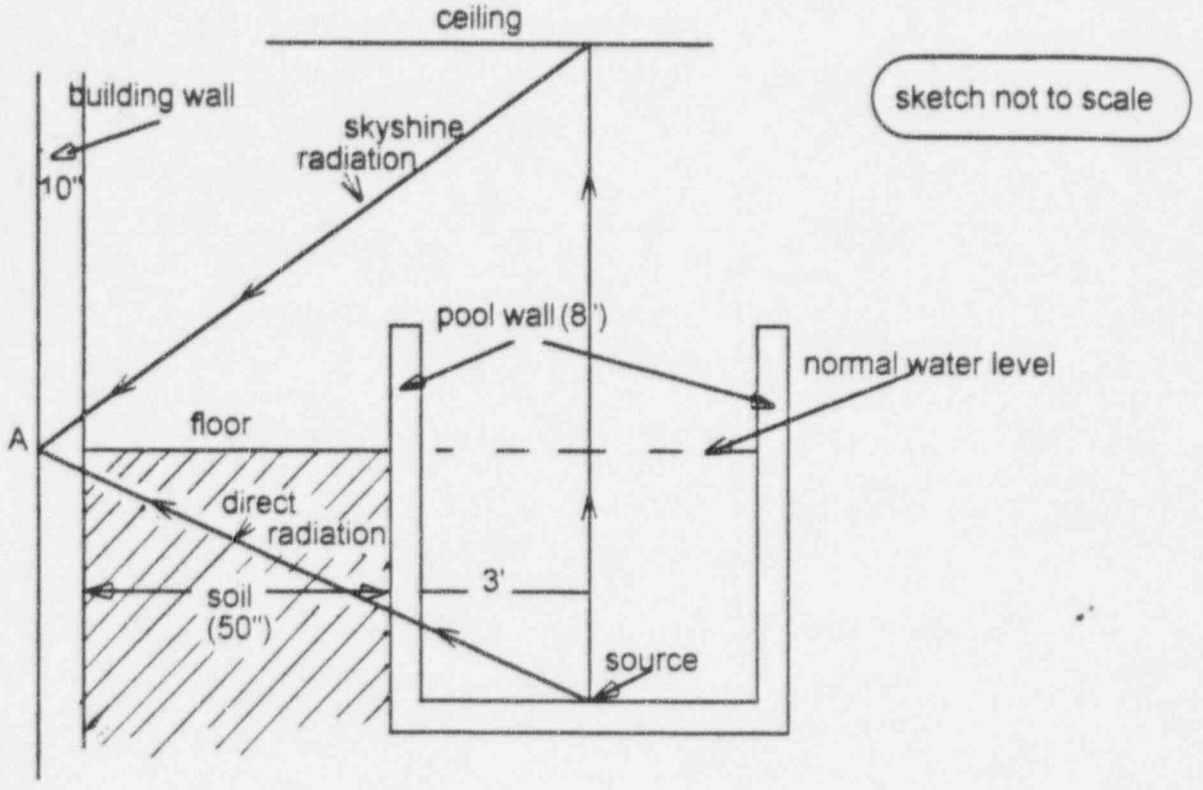


Diagram used in the calculation of the dose rate from the ^{60}Co source. Dose rate was obtained for point A.