

REPORT ON NUCLEAR ENGINEERING
AT THE
COLLEGE OF ENGINEERING
SEOUL NATIONAL UNIVERSITY

by

J. P. Hartnett, Ph.D.
University of Minnesota

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Seoul National University initiated an undergraduate program in Nuclear Engineering in April 1959 with a proposed enrollment of 20 students per year. Although it is difficult to determine precisely the reasons for this move discussions with members of the engineering faculty revealed that the following considerations played a role in the decision:

1. To provide engineers for the atomic energy industry of Korea
2. To provide technicians for the atomic energy industry of Korea

As reported in Reference 1 * "One factor in the decision to offer this work at the undergraduate level is the need for technicians as well as engineers. Recognizing the absence of any source of technicians for the nuclear field, the faculty decided to conduct a training program somewhat between the levels for the technicians and the engineer..."

3. To stay abreast of other universities

It is reported that two other universities in the Seoul area initiated undergraduate programs in nuclear engineering and to stay abreast of these institutions and to capitalize on the glamour of nuclear engineering the faculty at Seoul National University felt compelled to add a Nuclear Engineering Department with an undergraduate program.

4. To increase the number of engineering graduates

It is argued that more engineering graduates are needed by Korea and due to staff and student enrollment restrictions it was impossible to expand within the already existing departmental structure.

*1. Report on survey of National Higher Education in the Republic of Korea 1960.

5. To increase the number of permanent academic positions

The number of academic positions was rigidly fixed for the existing engineering departments. Within this quota there were not sufficient positions to accommodate all of the qualified personnel. The establishment of a nuclear engineering department creates new permanent positions thereby providing an opportunity for some of the temporary faculty to obtain tenure positions.

It is highly probable that all of the stated reasons played some role in the decision to add a Nuclear Engineering Department. Let us examine the list one by one:

1. To provide engineers for the atomic energy industry of Korea

This presupposes that the atomic energy industry in Korea will be capable by March 1963 of absorbing some 20 nuclear engineering graduates from Seoul National University in addition to the nuclear engineering graduates from other universities. It also implies that graduates of already existing engineering curricula such as Mechanical, Chemical, Metallurgical or Electrical Engineering will not meet the needs of the industry.

The author found it impossible to get any quantitative information as to the anticipated growth of the atomic industry and it is apparent that the faculty of engineering did not have such information when they formed the new department in Korea. At the present time the only establishment possibly interested in employing nuclear engineers is the Atomic Energy Research Institute and it is obvious that they will not be able to absorb the total output. Furthermore, discussions with the staff of the Atomic Energy Research Institute revealed that they are more interested in employing physicists, chemists and the "standard" types of engineers, namely chemical, mechanical and electrical. While there may be some merit in Reason No. 1 it would appear that it is impossible to fully document and its validity remains open to some question.

2. To provide technicians for the atomic energy industry of Korea

The role of the College of Engineering at Seoul National University is to educate engineers at a professional level and it is not its function to provide technicians. The faculty and facilities are not geared to this task and inspection of the proposed Nuclear Engineering Curriculum offers conclusive proof that it is not the present intention to provide vocational training. Reason No. 2 must be rejected as a possible legitimate justification for initiating a Nuclear Engineering Department.

3. To stay abreast of other universities

The initiation of new curricular and new engineering departments at Seoul National University should reflect the technological needs of the country and should not arise from the consideration of the actions of other universities; otherwise, one can foresee in the next few years the formation of departments such as Astronautical Engineering, Molecular Engineering, etc. It is realized that it is frequently a simpler task to convince university and governmental officials of the need to create new "glamour" departments than to expand existing departments. The faculty should realize that such overdepartmentalization does not serve the best interests of the country, the university or the students and consequently the faculty should resist the temptation to add new departments simply to stay abreast of other establishments.

If the faculty were really concerned with pressures from other universities and assuming the technical needs of the country justified the move an acceptable solution would have been the addition of a nuclear engineering option to the existing departments of Mechanical Engineering and Chemical Engineering or better still the offering of a nuclear engineering program at the M.S. level within the existing departmental set-up. This latter solution would require close cooperation between the faculties of the existing departments and would allow nuclear engineering education to be accomplished with a minimum of duplication of staff and equipment.

4. To increase the number of engineering graduates

At the present time the College of Engineering graduates more students than the Korean industry is capable of absorbing and a considerable number of graduates are unable to obtain engineering positions. In particular engineers trained in highly specialized areas such as Naval Architecture and Aeronautical Engineering are at a considerable disadvantage in competing for the available positions.

As pointed out in Reference 1 the major requirements of the country will be broad-gauged engineers such as Mechanical, Electrical, Civil and Chemical, soundly educated in the fundamental principles and exposed in the university laboratories to current practice. If indeed Korea does need more engineering graduates (and this highly questionable) it is not an acceptable solution to merely add a new department and a new curriculum without establishing the need for the new specialty.

5. To increase the number of permanent academic positions

While it is understandable that the faculty is interested in obtaining more permanent positions such an expansion must be based

on the needs of Korea and the creation of new academic positions per se is certainly not sufficient cause for the establishment of new departments. The other Korean National Universities may well be interested in adding faculty with the special educational background of the group at Seoul and some of the temporary faculty might well investigate the possibility of openings at these other institutions. Certainly in the future Seoul National University will be unable to absorb all of its graduates who are interested in university positions and in the best interest of the individual and of Korea the migration of such individuals to other National Universities should be encouraged. This solution has the additional possibility of establishing closer harmony between the National Universities of Korea.

In summary there appears to be little justification for the establishment of a Nuclear Engineering Department. Any legitimate needs could have been fulfilled by introducing special courses in nuclear engineering in the existing departments, offering them at either the undergraduate or graduate level. However, the fact remains that a Department of Nuclear Engineering with two permanent faculty members and a student population of some 40 students (20 freshmen and 20 sophomores) does indeed exist and the major problem is the future disposition of this group.

It appears impossible to eliminate an existing department at the college as evidenced by the fact that there are ten engineering departments currently in existence:

1. Chemical Engineering
2. Civil Engineering
3. Electrical Engineering
4. Electronic Engineering
5. Mechanical Engineering
6. Metallurgical Engineering
7. Mining Engineering
8. Naval Architecture and Aeronautical Engineering
9. Textile Engineering
10. Nuclear Engineering.

It should be mentioned that the present overdepartmentalization has some negative features including duplication of laboratory facilities and courses.

furthermore, it is practically impossible for a student to shift from one department to another either at the undergraduate or graduate level. Recognizing the technical needs of the country and the budget limitations on staff and equipment a more efficient educational arrangement would be as follows:

1. Chemical Engineering
2. Civil Engineering
Combine present Civil Engineering Department with the Naval Architecture and Marine Engineering Division of the Naval Architecture and Aeronautical Engineering Department.
3. Electrical Engineering
Combine present Departments of Electrical and Electronic Engineering
4. Mechanical Engineering
Combine present Mechanical Engineering Department with the Aeronautical Engineering Division of the Naval Architecture and Aeronautical Engineering Department.
5. Mining and Metallurgical Engineering
Combine present Mining Engineering Department and Metallurgical Engineering Department.
6. Department of Textile Engineering

Such a regrouping of departments would result in more efficient use of present staff and facilities and would produce the broad-gauged engineering graduates required by the present and indeed the future industries of Korea. Although the faculty realizes the advantages to be gained by such a move the pressures to create new departments, create new positions and build new empires apparently over-rides the other considerations and an "empire" once established with its vested interests is virtually impossible to eliminate.

It may be noticed that the Department of Nuclear Engineering does not appear in the proposed list of Engineering Departments. The omission is intentional but does not imply that the department should be eliminated. As

pointed out above, such a recommendation (i.e., to eliminate the department) would represent an academic solution with little likelihood of being implemented. Rather, it is suggested that the Department of Nuclear Engineering become the Applied Physics Department at the College of Engineering. Other surveys have recommended that the Physics Department at the College of Liberal Arts and Sciences at Chung Ryang Ri move to the College of Engineering at Shinkong-duk Ri but it is highly unlikely that such a move will occur in the near future. It is important that the College of Engineering have a Physics Department, offering undergraduate and graduate work in Physics if the engineering departments are to develop strong graduate programs. The Department of Nuclear Engineering could fill this role effectively by careful selection of future faculty members (i.e., selecting physicists who have shown proficiency in research and teaching) by providing a course of study in Applied Physics and by building up laboratory facilities in basic and applied physics. In addition the fact that the Atomic Energy Research Institute is located immediately adjacent to the College of Engineering should stimulate graduate level research and should certainly aid in the building of a strong physics faculty. Indeed, some members of the Atomic Energy Research Institute could well serve as special lecturers at the College of Engineering.

The proposed solution of re-directing the Nuclear Engineering Department into Applied Physics does create some questions. One of these involves the disposition of the 40 students currently in the program of study. Some of these students may not be interested in a straight physics program and furthermore this output of Physics majors may be more than the Korean economy requires. It is suggested that the students be informed of the change in emphasis in the program and those who elect to shift to other departments be allowed to

do so. It is suggested that the faculty reconsider the number of students to be admitted into the modified Nuclear Engineering Program with the probable number to be fixed somewhere between 15 and 20 students. In this connection it is further proposed that the assignment of all students in the College of Engineering to the individual departments be accomplished after the first year of study rather than at the time of entry to the college. The individual departmental quotas could still be enforced but some consideration to the special interests and abilities of the students could be taken into account.

It is proposed therefore that the Department of Nuclear Engineering in fact become a Department of Applied Physics, although it may be desirable to retain the present departmental name for some time to minimize disturbances within the university structure. Where then is Nuclear Engineering to be taught if a need arises? In that event, it is proposed that some specialized courses in atomic physics, nuclear physics, nuclear metallurgy, health physics, heat transfer and reactor design be offered at the graduate level to graduates of the Mechanical Engineering Department and the Chemical Engineering Department. The possibility of using the facilities of the Atomic Energy Research Institute for auxiliary laboratory work should be explored. In connection with graduate study at the College of Engineering the present requirement of an examination for admission to graduate study in a given department eliminates the possibility of a student changing his major field of study at the graduate level (i.e., it is impossible for a B.S. in Mechanical Engineering to study Chemical Engineering at the graduate level). The faculty agrees that this rule should be modified to increase the exchange of students and of ideas at the graduate level and action should be taken to accomplish this objective.

Finally, further mention should be made of the Atomic Energy Research Institute. At the present time the relationship between this establishment and

the universities of Korea is very nebulous. It would seem highly desirable that an effective program be spelled out in some detail to minimize the possibility of other Atomic Energy Institutes arising within the next few years. It is suggested that Seoul National University and the Atomic Energy Research Institute study the pattern of Brookhaven National Laboratory or Argonne National Laboratory in the United States in determining the interrelation of the laboratory and surrounding universities. It is reasonable to expect that the facilities at the Atomic Energy Research Institute will be generally available for high level research in Physics and Engineering by graduate students or faculty members from the various universities in Korea. It may also be possible to conduct some laboratory courses at the Institute making use of their highly specialized and expensive equipment. An especially strong bond should develop between the College of Engineering and the Atomic Research Institute since the Institute is located on the Seoul National University Campus.

SUMMARY:

Major Recommendations

1. Retain the Nuclear Engineering Department in name but change its content so that in fact it is an Applied Physics Department. New faculty appointments should be research-oriented physicists.
2. Add the present Professor of Physics in the Department of Basic Instructions to the Nuclear Engineering Department. The Basic Physics Laboratory would then be under the jurisdiction of the Nuclear Engineering Department and duplication of laboratory equipment will be avoided.
3. Establish in writing a working arrangement between Seoul National University and the Atomic Energy Research Institute along the lines of the programs of Brookhaven National Laboratory or Argonne National Laboratory.

4. If a need for "nuclear engineers" develops in the future, offer specialized courses in Nuclear Engineering at the graduate level to qualified students who have bachelor's degrees in Mechanical or Chemical Engineering. The graduates of such a program would receive a Master of Science in Mechanical Engineering or in Chemical Engineering with a Nuclear Engineering Option. The program would cut across existing departmental lines.

Auxiliary Recommendations

1. Inform present students in Nuclear Engineering of the change in emphasis in the curriculum. Allow those desiring to shift to other departments to do so.
2. In the future do not assign College of Engineering students to individual departments until they have completed the first year.
3. Eliminate entrance examinations for admission into graduate school, substituting the undergraduate performance record as a measure of ability to accomplish satisfactory graduate work. Allow students to shift major fields as they shift from undergraduate to graduate study.
4. Encourage competent graduates with M.S. and Ph.D. degrees to seek faculty positions at other National Universities throughout Korea.
5. Re-evaluate and consolidate the present alignment of engineering departments keeping in mind the technological needs of Korea and the budget limitations on staff and laboratory equipment.
6. Initiate plans for a Physics Laboratory including space and equipment (in addition to the present Physics Laboratories in the Department of Basic Instruction). The Laboratory Experiments entitled "Nuclear Physics Laboratories" and "Atomic Physics Laboratories" outlined in Appendix A, following, appear appropriate for such a laboratory.

Appendix A

A) Nuclear Physics Lab. I (for 20 students)

1. Absorption of gamma-rays
2. Compton Scattering
3. Diffusion cloud chamber
4. Positron annihilation and coincidence counting
5. BF₃ counter explorations of a neutron distribution
6. Determination of Decay Constants
7. Identifications of Nuclear Reactions by means of nuclear emulsion

B) Nuclear Physics Lab. II (for 20 students)

1. Geiger-muller and Proportional Counter Behavior
2. Factors affecting beta counting, beta absorption and Range-energy relationship.
3. Statistics Applied to Radio active Measurements
4. The scintillation well counter, gamma-ray spectroscopy
5. Absolute Counting including the use of Micro-Pipets
6. Characteristics of Radio Nuclides
7. Activation Analysis

C) Atomic Physics Lab. (for 20 students)

1. Determination of e/m of electrons: magnetic deflection method
2. Measurement of the electronic charge by the oil-drop method
3. Determination of e/m of Beta rays with relativistic calculation
4. Experiments on electron diffraction; determination of cathod ray wave length.
5. Determination of h/e of photoelectron

6. Experiment on the sodium spectrum (optical)
7. Experiment on excitation potentials of atom
8. Vacuum technique.