International Nuclear Data Committee (INDC), 19th Meeting
8-12 March 1993

The Committee reviewed the Agency's Nuclear Data Programme

9 of the 12 professionals of the RIPC Nuclear Data Section (NDS) are involved in
the Agency's Nuclear Data Programme. (For the other three professionals see a separate
paper on "Atomic and Molecular Data for Fusion".)

The Nuclear Data Programme, which is reviewed by the INDC in two-years intervals,
covers most of the Subprogramme G.1 on Nuclear and Atomic Data for Applications,
(except for the tasks on atomic and molecular data of this Subprogramme).

Attached is the report on above INDC Meeting (partly still in draft form) which
consists of an Executive Summary and reports of four subcommittees, i.e.

- Subcommittee on Data Centre Operations and Information Exchange
  (Project G.1.01)

- Subcommittee on Nuclear Data for Energy Applications
  (various items of Projects G.1.02 - G.1.04)

- Subcommittee on Nuclear Data for Non-energy Applications (Project G.1.04)

- Subcommittee on Nuclear Data Technology Transfer
  (all Projects of Subprogramme G.1)

Attention is drawn to

- the Executive Summary, pages 1-2;
- the primary roles of the IAEA Nuclear Data Center, p. 5;
- High-Priority Problem Areas in nuclear data, p. 8;
- nuclear data topics for non-energy applications, p. 14;
- manpower training and technology transfer, p. 20;
- recommended meetings and training courses, p. 24-26.
EXECUTIVE SUMMARY

The International Nuclear Data Committee (INDC) considered the programme of the IAEA's Nuclear Data Section (NDS) in the light of the Agency's priorities:

(a) the safe operation and development of nuclear facilities
(b) the transfer of nuclear technology for the improvement of human health and welfare especially in developing countries, and
(c) the safeguarding of nuclear materials.

Underlying the fulfillment of all of these goals is the fundamental requirement for vast amounts of varied types of nuclear data. The NDS plays a crucial role in the collection, analysis and dissemination of reliable nuclear data to the IAEA's Member States in support of these goals.

The Committee gives highest priority to the NDS's task of providing data services to its customers in Member States. The Committee applauds the purchase and installation of a VAX computer for use of the NDS. It forms a necessary first step in the modernization of the Center's data activities. The major near-term objective should be the full implementation of the NDS's data handling and customer services on this computer. The medium-term goal should be to improve the skill of NDS in the use of this facility and improve the software and capability of the computer facility with the long-term goal of developing the IAEA Nuclear Data Section into the world's premier nuclear data center.

The NDS's leadership role in the coordination of the nuclear data activities of regional and national data centers is crucial to the success of its major function. The collection and critical analysis of nuclear data is an enormous task which must be accomplished with limited and dwindling international resources. Judicious use of these resources requires a close coordination of regional and national data centers which exist to best serve local requirements. Coordination of worldwide scientific expertise is the most efficient mechanism for resolution of data issues of international interest. This task must be continued in both the short- and long-term plans.
The need is clear for internationally-agreed, critically-analyzed nuclear and atomic data to further the goals of IAEA Member States in developing specific nuclear technologies. The NDS's Handbook on Nuclear Data for Safeguards is an example of a nuclear data project which contributes significantly to a critical IAEA programme. The Committee recommends for the near term, that priority be given to the collection of critically analyzed nuclear data for fusion energy applications (in particular the ITER project), and in the intermediate term, activation data essential to many energy and non-energy related applications. Data required for developing inherently safer reactors for advanced fuel cycles, for disposal of radioactive waste, and for decommissioning of aged power plants will require increasing attention in the intermediate- and long-term plan.

The NDS should continue to place high emphasis on manpower training and nuclear data technology transfer to assist the nuclear programs of developing countries. In particular, the NDS should continue to assist in developing the capability to process and utilize available nuclear data files and in the development of local or regional data centers in the developing countries. NDS organized training courses are essential to the technology transfer goal.

The Committee recognizes that the NDS has a technical as well as administrative function. Technical activities are manpower intensive. It is essential that an adequate staffing level be provided to carry out the assigned technical tasks. The proper component of long-term staff to provide continuity in the Center's technical activity is encouraged. The future staffing profile of the NDS must be given careful thought and management so as to develop a proper mix of talents to most efficiently implement the programme. The Committee believes that staff exchanges should take place with other nuclear data centers to enhance the exchange of ideas and professional expertise.

INDC members are deeply concerned that the staff numbers and technical profile of the NDS should be sufficient and appropriate to maintain all of the key activities described above. Staffing difficulties are already reflected in the inability to hold all high-priority meetings and to provide all of the essential data services identified by the INDC. IAEA management should appreciate that personnel and funding cuts must be restored or the viability of the crucial NDS activities will be seriously jeopardized.
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CENTRE OPERATIONS AND INFORMATION EXCHANGE SUBCOMMITTEE (COIESC)

The IAEA Nuclear Data Section (NDS) is the coordinating centre for the maintenance and communication of a reliable nuclear database. This database includes relevant nuclear data libraries for a wide range of energy and non-energy based applications in the field of nuclear science. Both developed and developing countries, which are served by the NDS, face issues associated with the planning of their nuclear science and technology programmes. They require guidance in the adoption and usage of data files to assist a wide range of activities. A major concern is that sufficient support be provided to the NDS so that it can fulfil its role in serving as the world’s central nuclear data centre. A healthy level of support must be maintained to avoid a disastrous loss of expertise and organizational infrastructure within the centre, which would significantly undermine its natural leadership role to the national and regional data centres.

The primary roles of the NDS and its goals are adjudged to be as follows:

1) **Coordination of National and Regional Centres**: Provide a leadership role for the national and regional centres.

2) **Data Handling**: Modernization of data handling and customer servicing based on the full implementation of their computer system (at present a VAX) and associated systems.

3) **Servicing**: Improve and maintain rapid servicing of inquiries from member states.

4) **Maintenance of Codes and Data Bases**: Maintain data libraries and processing codes at a fully up-dated level.

5) **Educational Role to Member States and their Centres**: Provide an educational role to member states.

6) **Internal Profile of Centre**: Achieve and maintain healthy staff capabilities and morale based on in-house development of nuclear physics and computer expertise.
RECOMMENDATIONS

ACTION ITEMS  The items listed below are to be taken as action items by the NDS.

1. Coordination of National and Regional Centres:
   1.1) The most judicious use of worldwide talent and staff interaction requires a network of regional nuclear data centres. These centres exist as national entities to best serve their individual regional needs as well as maintaining specialized projects and local expertise. We recommend most strongly that the NDS, situated uniquely within the IAEA, coordinates this diverse set of centres and provides the most efficient forum for resolution of nuclear data issues of international interest.
   
   1.2) A number of meetings are essential to perform this coordinating role:
      1.2.1) annual technical data centre meeting,
      1.2.2) biennial meeting of centre managers.

2. Data Handling:
   2.1) Provide the expertise and leadership to assure that member data centres have practical, affordable and acceptable forms of communication links. NDS requires adequate staffing levels and appropriate data handling facilities. A VAX system has been purchased to achieve these NDS goals; training and additional hardware are required to attain maximum efficiency in handling customer requests for data with this facility.
   
   2.2) Faced with rapid developments in information and communication technology, the NDS needs to have a clear awareness of modern computerized facilities and potential capabilities, and appreciate when to adapt and improve these communications.
   
   2.3) Communications between the regional data centres must be maintained when improvements occur as described in 2.2.

3. Servicing:
   3.1) The NDS must provide the leadership in producing a series of primary data libraries from the various source files that are now freely available. These primary libraries must represent sets of definitive and recommended data for each parameter. As an example, it is noted that NEA Data Bank staff have partially undertaken such a task to produce single sets of recommended data for JEF-2 by assessment and compilation.
   
   3.2) Since the NDS customers come from centres and countries with a wide variety and depth of capabilities, the customer inquiries come as various forms of request. Those requesting a recommended single datum should not have to be confronted with several different sources or values. Thus, the NDS should have the wherewithal to provide single values and, hence, be able to work towards a single set of recommended data (see above).
4. Maintenance of Codes and Data Bases

4.1) The NDS staff must be committed, at the very minimum, to the maintenance of the following data bases:
   (a) CINDA  
   (b) EXFOR  
   (c) WRENGA  
   (d) Universal base set of data libraries as described in Section 3.1.  
   (e) Important data needs that must be decided by the technical subcommittees of the INDC.

4.2) The requirements for processing codes should be reviewed periodically, and any necessary improvements and modifications be made upon the basis of this review. A similar exercise should be carried out for specialist, applications-based data files (e.g. geophysics, safeguards, standards, etc).

5. Educational Role to Member States and Their Data Centres

5.1) Some effort should be set aside to guarantee the successful operation of existing and future national and regional data centres. This will require the establishment and running of exchange workshops and teach-ins.

5.2) Provide training on the full range of talents needed for the efficient and knowledgeable operation of off-site centres (see exchange program described below in section 6.2).

6. Internal Profile of Centre:

6.1) The professional/staff profile of the NDS must be given careful thought and managed so that the healthiest synergisms are established. Staff morale is important. This requires the optimum balance of relevant capabilities and technical programmes covering nuclear physicists, mathematicians, and computer systems scientists.

6.2) In order to provide the optimal service and most judicious use of talent, there ought to be in-depth staff exchanges between the NDS and the national data centres (see 1.2 and 5.2 above).

Sub-committee Membership

Those present and/or providing input:

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A.L. Nichols (Secretary)  
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SC ON NUCLEAR DATA FOR ENERGY APPLICATIONS

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1. High-Priority Problem Areas

1. The Subcommittee strongly recommends that the NDS should continue to consider nuclear data services to customers (compilation, formatting, evaluation and dissemination of computerized nuclear data) as their main task. More than 60 Member States rely on these services of the NDS and the co-operating data centres. The IAEA should therefore ensure that the basic reference files of nuclear reaction, structure and decay data (CINDA, EXFOR, ENDF) are kept complete, up-to-date and of high quality. (It was stated during the discussion that these files constitute the “real treasure of the nuclear community”.) The upgraded computer facilities, and the fact that NDS, NNDC, NEADB are using now compatible computers with the possibility of identical handling programs, is noted with satisfaction.

2. The SC considers nuclear data for fusion energy applications as of special importance at present, with Engineering Design Activity for ITER agreed for the period 1992–1996. It commends NDS for the progress made with the FENDL file that is not only valuable for fusion technology, but also for accelerator-driven transmutation, radiotherapy, and many other applications.

3. Nuclear data for fission reactor technology including the entire fuel cycle (advanced and inherently safe reactors, radioactive-waste management, decommissioning of aged power reactors) require continuing if not increasing attention. Close co-operation with the relevant Subgroups (e.g. on Data Needs in Future/Advanced Reactors) of the NEA Nuclear Science Committee is recommended.

4. Activation cross sections for neutrons and charged particles are another high priority area for the future NDS activity, needed for safe handling of fission and fusion reactor components, activation analysis, or the planning of reliable and safe disposal of radioactive nuclear waste.

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5. Intermediate-energy cross sections for neutrons, protons and alpha particles are of growing importance for accelerator shielding, nuclear-waste incineration, space programs, biomedical applications etc. It is recommended that the NDS coordinate EXFOR compilation of measured data for incident energies from 20 MeV to about 1 GeV. As such data will remain scarce for a long time NDS should also organise further development of nuclear reaction models and model codes for their prediction.

2. Review of Actions from 18th INDC Meeting

The Subcommittee reviewed the actions from the past INDC meeting. Most of them had been fulfilled. Others have the character of standing actions, e.g. those for NDS to consider, as far as feasible, joint places for SM, CM and RCM meetings on related subjects; or to encourage laboratories in member countries cooperating in the FENDL project to help with data processing (see under 4. below)

3. Tasks Planned by NDS Until 1996 (cf. P(93)-10)

Project G.1.01

Nuclear and Atomic Data for Applications

7. Development of standard input data sets for nuclear-model computations of nuclear data

This is a very ambitious task with great potential benefit to many applications in science as well as technology: The plan is to standardize the present plethora of optical models and other nuclear-reaction models, and to provide standard model parameters for applied computations. This was considered unanimously as having high priority. The SC strongly endorses the task, although it may require extension beyond the usual CRP duration.

Project G.1.02

Establishment of Improved Nuclear Data Sets for Fission Reactor Technology and Safety

1. Technical document on the requirements of nuclear data for advanced reactors:

An AGM was planned for 1993 but Lone and Nakjima pointed out that there will be three conferences this year on advanced reactors including fuel cycle questions: GLOBAL 93 in Seattle, INC 93 (Toronto) and ICENES in Japan (Tokyo area). The SC therefore suggests to NDS to wait for the
output from these meetings and to move the AGM foreseen for 1993 to 1994. Lone accepted an action to inform NDS of nuclear data needs apparent at the meetings in North America, Nakajima will do the same for the meeting in Japan.

2. Co-ordination of integral benchmark testing and sensitivity studies of the FENDL nuclear data base:

This Task, with an AGM planned for 1993, is considered as of high priority for the coming years, in view of the Engineering Design Activity agreement for ITER and the resulting obligations for NDS. The SC urges NDS to strengthen co-operation with the corresponding NEA-NSC subgroup (Dr. Pelloni) as much as possible.


This is a medium-term task, already under way. Results will be assessed by a CS foreseen for 1994.

4. CRP on the compilation and evaluation of fission yield nuclear data:

This task is well under way and has led to important additions to the NDS files (see P(93)-21). Important contributors are Rudstam (Sweden), and the UK (James, Mills) and US (England) projects. The bulk of the work is such that an extension of the CRP is called for. Before recommending the extension, the SC needs from NDS an intermediate report.

5. Establishment of database: spectra of light and heavy nuclear reaction products needed for radiation damage estimates of fission reactor materials.

The SC considers this as a task for the medium term and of potentially very broad scope. Its utility will not be restricted to fission reactors. Fusion and high-energy accelerator technology is developing similar needs.

6. Establishment of database: neutron resolved resonance cross sections for reactor materials, for safety coefficient calculations:

This task is directed towards self-shielding coefficients. In the SC discussions it was said that the computational methods are well developed. Analytical approximations can be checked by Monte Carlo ladder methods. This task may have a useful pedagogic function for scientists from developing countries but appears less urgent for advanced laboratories.
7. Technical document on review of representation and processing of neutron cross sections in the unresolved resonance region:

A consultants meeting will be held in Sofia in 1994 to discuss the scope of a CRP. This task could be combined with the previous one.

Project G.1.03

The Establishment of International Reference Libraries of Nuclear and Atomic Data for Use in Fusion Reactor Technology

1. Development of uncertainty files and updating of previous multigroup cross section files for fusion reactor materials contained in the Fusion Evaluated Nuclear Data Library (FENDL):

The SC considers this as timely and of high priority. An AGM will be held at JAERI in 1993.

2. Co-ordination of integral benchmark testing and sensitivity studies of the FENDL nuclear database:

This is interrelated with, and a logical follow-up to the previous task, and thus also of high priority. An AGM is foreseen for 1994.

3. Co-ordination of the development of an international library of charged-particle fusion reaction cross sections:

The objective is to make data on thermonuclear reactions involving the lightest projectiles and nuclides internationally available, as they exist at LANL, LLNL and Arzamas. Most of the technical work will be done at these laboratories, NDS will co-ordinate. As the data are important not only for fusion but also for transmutation work and cancer therapy, and of a well-defined, manageable scope, the SC endorses this task.

4. CRP on activation cross sections for the generation of long-lived radionuclides:

This CRP is ongoing. A second RCM is scheduled in San Diego in 1993.

5. CRP on the improvement of measurements, theoretical computations and evaluations of neutron-induced helium production cross sections:

A first RCM was held at Debrecen in 1992, and the CRP is well under way. The SC took note on the valuable results obtained already, not only concerning the data but also with respect to level density and other model parameters for model calculations. Close cooperation with scientists outside the CRP (e.g. V. Avrigeanu) was beneficial.
6. CRP on the measurement, calculation and evaluation of photon production cross sections:
   This task is foreseen for the period 1994-1998. It is of relevance for a broad range of applications such as radiation hazard, energy deposition, reactor decommissioning, and safeguards. The SC endorses this as a task for the medium term.

Project G.1.04


1. Technical document on nuclear data for design, operation and safety aspects of nuclear waste incineration facilities:
   An AGM foreseen for 1993 was deferred to late 1994 or early 1995 in order to utilise input from forthcoming international conferences.

2. Establishment of database of fast fission and capture cross sections for minor actinides:
   The discussion of the SC revealed that, although minor actinides are of continuing concern, and the available evaluated data are not as good as those for the major actinides, they are not a major concern at present. It is therefore recommended to widen the scope of the CRP to actinides in general.

3. Establishment of database: nuclear data for neutron emission in actinide fission:
   The SC noted the outcome of the CM held already, which served to clarify basic physics aspects of fission neutron emission, and the new data that became available on the neutron spectra. It was stated that spectrum shapes are quite well predictable at present but that absolute values (nu-bar) and their dependence on Z, A and E are of main concern. This may require a different CRP later on (1996-98).

4. Establishment, in coordination with NEA, of improved neutron cross section database of long-lived fission products for fission product waste incineration:
   This is seen as a task for the medium term in an area of growing importance.

5. Establishment of database: International reference data library of nuclear activation cross sections (Phase 1: particle energies up to 20 MeV)
   This is a task of high priority, based on recommendations from a large number of groups working on fission and fusion issues. An Advisory group meeting in 1994 is endorsed.
6. Development of bibliographic and numerical bases of nuclear data for intermediate-energy applications (Phase 1: co-ordination of the compilation of available experimental data)

This task is endorsed for the medium term. In fact, valuable input is already available, e.g. from Michels, Germany.

7. Development and testing, in co-ordination with NEA, of nuclear models and computer codes for the computation of intermediate energy nuclear data

This is a follow-up step for the preceding task, endorsed by the SC.

9. Establishment of database: recommended reference values for secondary standards for the calibration of intermediate energy nuclear data

This is to be seen in the same context as the two preceding tasks, endorsed by the SC.
Subcommittee on Non-Energy Applications

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The scope of the subcommittee included activities that are primarily not in the areas of fission or fusion energy or in the area of technical cooperation. Rather, the following applications are considered: reference nuclear databases for nuclear waste disposal including reactor and acceleration transmutation of radioactive waste, environmentally safe nuclear waste disposal, applications of intermediate energy radiations, medical applications including radiation therapy and isotope production, geophysical exploration, nuclear safeguards, elemental analysis, industrial applications, and basic nuclear physics. Standard reference data supporting these and other applications are a major responsibility of this subcommittee.

Actions from the 18th INDC meeting relevant to this subcommittee were reviewed.

Action 11: on R. Peclle to explore again, when timely, with the author whether the database prepared by W. Poenitz for ENDF/B-VI can be made available to the data centers.

Response: Poenitz has a database of more than 10,000 points which have been carefully evaluated and many have been corrected after discussions with the experimenters. This very valuable database needs to be documented. Unfortunately, Poenitz is not presently supported to do this. It was recommended that funding agencies be encouraged to support this important work. Continuing action on R. Haight.

Action 23: on INDC members to explore the availability of evaluations of high priority monitoring reaction cross sections for radioisotope production in medical applications.

Response: Shubin (Russia) has new, calculated data. Standing action.
Action 24: on NDS and INDC members to explore the terms of coordination with national or regional data centers for compilations and exchange of experimental nuclear data in the intermediate energy region for nuclear energy and technique applications and radiation effect estimates (standing action) and to promote with other data centers a collaboration for producing a quick, even if preliminary, version of the IEND file proposed by the October 1990 AGM.
Response: Compilations are being pursued at St. Petersburg and Kurchatov. A bibliographic file exists at NDS. Completed.

Action 25: on NDS to enquire the exigencies to hold a CM on nuclear data for shielding in proton accelerators.

Action 26: on J. Boldeman to enquire with the Safeguards Division about the actual interest in the Handbook on Nuclear Data for Safeguards.
Response: Not done; however see the following discussion on Safeguards. Completed.

Action 27: on NDS to produce the Handbook of Nuclear Data for Safeguards.
Response: See discussion below. Completed.

Action 28: on NDS to disseminate information concerning the handbook and database of nuclear data for geophysical application.
Response: Publicized well in geophysics journals. Completed.

Action 29: on NDS to investigate the possibility of extending the database of evaluated neutron cross sections for nuclear activation analysis by including data above 10 MeV.
Response: A CRP is proposed for this work. Completed.

Action 30: on NDS to consider the terms for publication of the Handbook on nuclear data for neutron radiotherapy.
Response: Camera-ready copy to be provided to NDS by the CRP participants by end of June, 1993. Completed.
Nuclear Data Standards were discussed at length. The present situation as to what international body should look after standard cross section data is unclear because the NEANDC, which had coordinated most of the international work, no longer exists. One of its last acts was to complete the Nuclear Cross Section Standards report NEANDC-311(U), INDC(SEC)-101. The following actions were agreed:

**Action on NDS:** Distribute INDC(SEC)-101 as widely as possible.

**Action on INDC and NDS:** Establish a standing subcommittee of the INDC on standard reference data. This subcommittee should include representation of both NEA and non NEA countries.

**Action on INDC Standards Subcommittee:** Work closely with NEA standards working parties and interlaboratory collaborations where appropriate.

**Action on INDC Standards Subcommittee and NDS:** Work toward extending primary and secondary standards to above 100 MeV.

**Action on INDC members:** Try to find funding so that the extensive cross section standards database of W. Poenitz can be documented. There are over 10,000 experimental data points here, and the data have been carefully evaluated as the basis of the ENDF/B-VI standards file. This is an extremely valuable data set which must not be lost.

The Handbook on Nuclear Data for Safeguards was distributed in a preliminary version in 1991. It contains data that are greatly improved over what safeguards inspectors were using previously. There have been feedback and positive comments from six safeguards experts and nine data experts. The question now is what format is best for the data, hard copy or computer-readable format suitable for a PC.

**Action on J. Boldeman:** Ask safeguards experts which format they prefer.

**Action on M. Lammer:** Prepare a manual for using these data on a PC.

**Action on NDS:** Complete a final publication of the Handbook on Nuclear Data for Safeguards.
Many meetings (AGM, SM, CM, RCM) and other proposed activities of the NDS were discussed.

Continuing CRP on "Improvement of Measurements, Theoretical Computations and Evaluations of Neutron-Induced Helium Production Cross Sections": This is off to a strong start at the first coordination meeting in 1992. 
**Recommendation:** Continue at full speed as planned. Second meeting to be held probably in 1994 and the third in 1995 or 1996.

Continuing CRP on "Activation Cross Sections for the Generation of Long-Lived Radionuclides of Importance in Fusion Reactor Technology": Although this CRP is primarily for fusion energy, it also has basic reaction physics content. The second RCM is scheduled for April 1993 and the third RCM in 1994 or 1995. 
**Recommendation:** Continue at full speed as planned.

Newly proposed activities are listed below with the highest priority activities as judged by this subcommittee, listed first:

1. **Reference Nuclear Parameter Library for Nuclear Data Computation**

   In the calculation of nuclear cross sections, many parameters are needed. This reference library would allow researchers to use the same parameter sets for a variety of purposes: code comparisons, labor reduction, quality control and assurance to regulatory agencies, development of nuclear reaction models, and so forth.

   For some parameters, the models themselves must be well specified (e.g. spherical or deformed optical models and the appropriate parameters for each). Assembling this library is recognized as a big job and one that will take several years. On the other hand, there would be high prestige and visibility attached to this work. A consultants meeting has already taken place and has helped to define the problem. A second CM is planned for June, 1993. 
   **Recommendation:** Highest priority as viewed by this subcommittee. Proceed as proposed.

2. **International Chart of the Nuclides including the Standard Reference Data Library of Radioactive Decay Half-Lives:** Many (over 7) databases of radioactive decay half-lives and properties of the decay radiations exist at present. These badly need to be evaluated and
coordinated so that a recommended library of data is available to users. Thermal neutron cross section values and resonance integrals in BNL-325 are over 10 years old and also need updating in view of new measurements and other evaluations. Creation of an improved database for a chart of the nuclides would be a significant contribution to all of nuclear science and would have high visibility either as a wall chart or as a computer-readable file. It will require significant effort by the NDS.

**Recommendation:** Proceed as proposed with a consultants' meeting in 1994 and a following CRP.

3. **Establishment of an International Reference Data Library of Nuclear Activation Cross Sections:** This activity would serve to coordinate several national and regional programs and would update previous IAEA activation work of a decade ago by including the many new experimental results, more modern calculations, new physical processes such as sequential reactions, and realistic uncertainty values. Significant NDS resources would probably be required.

**Recommendation:** Proceed as proposed, first with a specialists' meeting to consider the neutron energy range up to 20 MeV and a following CRP.

4. **Evaluation of Photonuclear Reaction Data:** These data are required when photons from accelerator induce reactions such as \((\gamma,n)\) either intentionally, for elemental and isotopic analysis and radioisotope production, or collaterally, such as in food irradiations. National and regional evaluations need to be coordinated so that an international photonuclear data library will be available to users. This coordination effort should not require major NDS resources.

**Recommendation:** Proceed as resources are available for a CRP.

5. **Evaluation of Cross Sections of Monitor Reactions for Neutrons with Energies above 20 MeV and Charged Particle Reaction Data (non-Fusion Plasma):** Applications of these data include accelerator experiments, accelerator shielding, sequential reactions for radiation damage, medical isotope production, and medical therapy. The proposed work as discussed here combined these two activities and consequently lacked focus. Although these evaluations could have significant utility, it is recommended that NDS return at the next INDC meeting with a better defined project.
6. Projects related to transmutation of radioactive waste, e.g. Neutron Induced Fission and Capture Cross Section Calculations of Actinides: Several important meetings outside the IAEA are planned for the next two years in this rapidly developing field.

Recommendation: The NDS should continue to be well informed on developments in transmutation of radioactive waste by accelerators and reactors. Major research efforts by NDS in this area are considered to be premature at this time.

7. Physics of Fission Neutron Emission: Although the physical processes are of great interest to basic science, the need of new data for applications is at present not urgent.

Recommendation: Not appropriate for proposed CRP at this time.

One task was listed in the Nuclear Data Programme 1993-94 but had no proposal from NDS for meetings or other activity. That is a CRP on Measurement, Calculation and Evaluation of Photon-Production Cross Sections, item 6 under section G.1.03. A very large quantity of data from monoenergetic and white neutron sources is becoming available. With high resolution gamma-ray detectors, information can be derived on partial reaction cross sections, production of stable or long-lived residual nuclei, and the population of many resolved residual states that expand greatly the physics of the type pursued for many years from isomeric ratio data. It is highly recommended that the NDS look into this type of research so that experimenters, theorists, and applications researchers can be brought together to assess the physical content of this approach and the many applications including energy transport in reactor components, protection of sensitive detectors, transmutation of radioactive waste, and transmutation of structural elements to stable or long-lived isotopes of other elements.
The Sub-Committee strongly endorsed the earlier recommendation that in view of growing nuclear programmes of developing countries, the NDS should continue to put high emphasis on manpower training and nuclear data technology transfer in these countries. NDS should assist them to develop indigenous capability in the computer processing and utilization of the available nuclear data files for applications in nuclear research, energy and other areas such as radiation therapy, isotope production, geophysical exploration etc.

2. The NDTT Sub-Committee reviewed the actions arising from the 18th meeting concerning transfer of nuclear data technology. It noted that most of the actions have been fulfilled successfully. Action 47 to explore the possibilities in Germany for an official approach to the IAEA concerning the ITC on Neutron Generators to be held in Dresden in 1992/93 could not be fulfilled by prevailing circumstances. The SC recommended to drop this action. Action 51 to prepare a detailed programme and planning for the ITC on measurements in applied gamma spectroscopy, which could also not be fulfilled, is recommended to be continued in a modified form in cooperation with the Physics Section. Also Action 46 has been reinforced and highly recommended by the SC to remain a standing action on NDS to continue further attachment of fellows from developing countries to data evaluators in advanced laboratories.

3. The Sub-Committee reviewed the outcome of the interregional technical cooperation project TC/INT/1/039, and a regional TC project on XRF laboratory network, and alone with the Physics Section in the implementation of these programmes. The Sub-Committee agreed that such activities, although important for training in the application of nuclear techniques, do not have a direct relation on the main
responsibilities of the NDS. It was noted that involvement of NDS in these tasks is at present minimal, as available manpower at NDS does not permit it to take large responsibilities for these tasks.

4. The SC considered in some detail different workshops, ITC, CRP/Consultants' Meetings organized or proposed for training purposes. The SC recommended the following:

(a) The future joint IAEA/NDS-ICTP workshops have been serving a very useful purpose towards nuclear data technology transfer and the SC strongly endorsed its continuation as proposed in INDC/P(93)-22. It was also recommended that participants from those laboratories, which have active programmes to utilize their skills on return, should have a higher priority in selection of these courses. The present course directors, Prof. A. Gandini, Dr. S. Ganesan and Dr. J.J. Schmidt, were requested to see to what extent this could be implemented.

The proposal for the 1994 ICTP Workshop was strongly endorsed.

(b) A proposal for an ITC on "Application of Nuclear Data and Measurement Techniques in Nuclear Reactor Dosimetry", Obninsk, The Russian Federation, 13 June - 8 July 1994 was discussed. It was noted that the previous course at Obninsk in 1992 has been very successful.

While strongly endorsed the above proposal for an ITC at Obninsk in 1994, the SC was of the opinion that the title of the course does not accurately reflect the course content. The proposed ITC is strongly endorsed by the SC and Mr. A.B. Pashchenko was requested to determine a suitable title of the course in correspondence with Obninsk.

(c) The proposal (INDC/P(93)-12) for an ITC on "Methodology of Nuclear Data Evaluation and Evaluated Nuclear Data Library Management for Reactor Technology" at Beijing, China, 1995, was discussed. The SC felt that it would be better to have separate ITCs on "Methodology of Nuclear Data Evaluation" and on "Evaluated Nuclear Data Library Management Technology", since these two topics address participants involved in different types of activities.
The proposed ITC at Beijing, China, is recommended to be held in the beginning of 1995 with the slightly modified title of "Methodology of Nuclear Data Evaluation". Mr. Liu Tingjin was requested to arrange suitable modification in the course content in the final proposal, in the light of the new title.

Mr. Ricabarra informed about the possible interest in Brazil or Argentina to hold an ITC/RTC on "Evaluated Nuclear Data Library Management for Reactor Technology" around the end of 1996. The necessary proposal in this regard will be put up by him at the next INDC meeting.

(d) The SC discussed the proposal for a Consultants' Meeting to formulate the need and scope of a CRP in nuclear data processing of basic evaluated files (INDC/P(93)-19) for various application calculations. The proposed consultants' meeting/CRP is on the topic of nuclear data processing of basic evaluated files to satisfy the urgent need to provide a consistent and correct multigroup data for core physics and shielding applications for thermal, fast and fusion research and power reactor applications derived by processing ENDF/B-VI, JENDL-3.1, BROND-2 and CENDL-2 libraries. The SC agreed that such a CRP will also meet the objectives of technology transfer to developing countries from developed countries in addition to providing valuable manpower support for such tasks in projects that are on-going (e.g. fusion) in developed countries as there are common steps in the application calculations. The SC recommends that the NDS should determine in what best way the main objective of the proposal can be met, since the participants will be submitting proposals for technical contracts rather than research oriented contracts.

(e) It is learnt that as a follow up of the 1992 ITC at ANL, the next ITC on experimental nuclear spectroscopy is scheduled in 1995, which will include $\alpha$-, $\gamma$- and x-ray spectroscopy. Dr. Kocherov was requested to find out further details, and NDS was recommended to participate in this as these courses are considered very useful for manpower training in nuclear data transfer technology.
5. The SC strongly endorsed the need to continue efforts in technology transfer, particularly nucleating and strengthening nuclear data centres in developing countries. The SC took note of the successful implementation of a TC project in China (CPR/1/004) and of the on-going projects in Algeria (ALG/1/011) and Indonesia (INS/4/027). Similar projects should be continued and supported by the Agency to establish self-propelling and self-supporting centres in these countries.

6. The SC strongly endorsed the continuation of the WIMS Library Update Project in order to make available updated multigroup constants in WIMS format for thermal research and power reactor applications. This project is in line with the Agency’s objectives on technology transfer.
RECOMMENDED LIST OF MEETINGS ON NUCLEAR DATA
(Meetings of the A+M Unit were not considered)

Note: In the final version the short titles of the meetings will be replaced by the full titles as given in the Subcommittee reports.

A. Management meetings, top priority

1. Next INDC Meetings in 1995, 1997, ... (now 2-years cycle instead of previously 18-months cycle)

2. Network meetings of the Nuclear Reaction Data Centers: annual, as before

3. Network meetings of the Nuclear Structure and Decay Data Evaluators: next in 1994, then in 18 months intervals, as before

B. Scientific meetings

including all types except RCM

Approved for 1993:

4. AGM at JAERI: FENDL uncertainties

5. SPM at JAERI: Experimental Techniques for Activation Cross-Section Measurements

6. CM in Ancona or Bologna: Nuclear Model Parameters

Recommended for 1994, top priority

7. CM or AGM on International Database for Activation Cross-Sections (envisaged to be followed by a CRP)

8. AGM on Nuclear Data Needs for Advanced Reactors

9. CM or AGM on International Database for Nuclear Decay Half-Lives (envisaged to be followed by a CRP)

10. CM or AGM on FENDL Benchmark Testing
    (This requires the availability of the final version of the FENDL database, so that the appropriate time of the meeting would be end of 1994. If needed, it could be moved to the beginning of 1995).
Meeting topics recommended for 1995/1996

11. CM on charged-particle fusion data

12. CM to review the database for reactor decommissioning (follow-up of a 1992 meeting)

13. AGM on nuclear data needs for decommissioning

14. CM or AGM on improved neutron cross-sections for long-lived fission-products

15. CM in Sofia on unresolved and resolved neutron resonance data (envisaged to be followed by a CRP)

C. CRPs

1. Neutron induced Helium-production cross-sections: ongoing, until 1995

2. Activation cross-sections for long-lived radionuclides: ongoing, until 1995

3. Fission-yield nuclear data: ongoing, recommended for extension until 1996


D. Training Courses

1. IAEA/NDS - ICTP Workshop on Nuclear Reactors - Physics, Design & Safety Trieste, Italy 11 April - 6 May 1994

2. ITC on "Methodology of Nuclear Data Evaluation" Beijing, China 1995

3. ITC on "Applications of Nuclear Data and Measurement Techniques in Nuclear Reactor Dosimetry" Obninsk, Russia 13 June - 8 July 1994

4. ITC on "Applied Gamma Spectroscopy" Place ? 1995?

5. ITC on "Nuclear Spectroscopy" ANL, USA? 1995

6. ITC on "Evaluated Nuclear Data Library Management for Reactor Technology" Brazil/Argentina 1996?

7. IAEA/NDS-ICTP Workshop on Nuclear Theory relevant to Nuclear Energy Applications Trieste, Italy 1996?

Note: The proposals for meetings at Sr. no. 4 to 7 are at present not firm