

**NUCLEAR INSTRUMENT  
MAINTENANCE AND TECHNICAL TRAINING  
IN NUCLEAR ENERGY UNIT.**

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**ABSTRACT:**

Instrument maintenance service is a necessity in a Nuclear Research Institute, such as the Nuclear Energy Unit (NEU) to ensure the smooth running of our research activities.

However, realising that maintenance back-up service for either nuclear or other scientific equipment is a major problem in developing countries such as Malaysia, NEU has set up an Instrumentation and Control Department to assist in rectifying the maintenance problem. Beside supporting in house activities in NEU, the Instrumentation and Control Department (I & C) is also geared into providing services to other organisations in Malaysia.

This paper will briefly outline the activities of NEU in nuclear instrument maintenance as well as in technical training.

1.0 INTRODUCTION:

It is common experience that maintenance of nuclear instrument of all kinds in a developing country like Malaysia present numerous difficulties. Many factors contribute to these difficulties such as:-

- i. lack of suitable qualified technical staff to undertake such repair.
- ii. inadequate technical support from local suppliers representing the manufacturers.
- iii. lack of the supply of spare parts in the local market.
- iv. no in house capabilities for repair and servicing in most institutions.

Nuclear instruments are not only costly, but they are also difficult and costly to operate, store and maintain. Because of the factors above, in some organisations, whenever anything goes wrong with this type of instrument, they have no alternative but to send them back over a long distance to the manufacturer. While the instruments are away, research activities will be affected. In addition to repair cost, the cost of air-freight, shipping and insurance cover will be immense. Hence, by having local people sufficiently trained on the proper operation and maintenance of these instruments, a certain amount of nuclear instruments maintenance could be done locally, thereby would not cause unnecessary delay or unnecessary payment of repair cost.

Nuclear Energy Unit (NEU) is a multi-disciplinary organisation where research and development work is being done in the fields of Nuclear Physics, Nuclear Chemistry, Radioisotope application, Nuclear Biology, Instrumentation and etc. Evidently a large number and type of instruments are being used and keeping these instruments operational has received the highest priority and of great concern by the management.

An Instrumentation and Control Department has been established in NEU to look after the instrument and maintenance, so that research work does not suffer from instrument failure or excessive down time.

Other than instrument from NEU, maintenance services are also given to other institutions not only to government agencies to the private sectors as well.

## 2.0 ACTIVITIES OF INSTRUMENTATION AND CONTROL DEPARTMENT IN RELATION TO NUCLEAR INSTRUMENTS.

Activities of this department includes:-

- i. installation and acceptance test
- ii. maintenance and calibration.
- iii. modification and/or development.
- iv. technical advice.
- v. training.
- iv. stock of spare parts.
- vii. printed circuit board (PCB) design.

## 2.1 INSTALLATION AND ACCEPTANCE TEST.

When a new piece of instrument is bought by NEU, it has to undergo an acceptance test. Acceptance testing is undertaken to ensure that:-

- i. the performance of an instrument meets the technical and performance specifications quoted by the manufacturer.
- ii. having all the necessary documents such as operation/ service manuals, circuit diagrams and test certificate.

This test is carried out immediately upon installation so that the supplier can be informed of any damage, deficiencies or flaws before the warranty period has expired. No instrument should be put into routine use unless it has been shown through acceptance testing that it can perform optimally.

If an instrument does not perform correctly, the supplier will be informed immediately to remedy the problems. NEU will without payment of a part of the purchase price until acceptance testing has been satisfactorily completed.

Every documents such as service manuals, operation manuals, circuit diagrams and an instrument information record card are kept in a file under the name of the instrument. The file is then placed in the manual's library. All the service and operating manuals for all the instruments must be preserved so that in doing trouble shooting one does not face much problem. An equipment tag number will then be assigned to every piece of equipment bought by NEU. The assignment of the tag number is automatically done by a computer program which will be discussed in the following chapter.

## 2.2 MAINTENANCE AND CALIBRATION

### 2.2.1 Type of Maintenance

Maintenance is the generic term of various measures taken against system troubles such as test, inspection, troubleshooting, repair and replacement.

Maintenance is usually classified into preventive maintenance or PM for short and corrective maintenance or CM.

To ensure stable operation of the instrument, thorough preventive maintenance is ideal and most effective but it costs much due to costs incurred in preventive inspection, replacement of parts, etc. In the case of corrective maintenance the most important factor is the downtime of the instrument.

### 2.2.2 Corrective Maintenance

The multi-disciplinary nature of NEU's research programmes inevitably involves the use of a very wide range of instrument ranging from simple instruments to highly sophisticated system.

With instrument that are not in good working conditions, research programmes will be imploded. To esure the smooth running of the research activities, the responsibility of maintaining the instrument has been entrusted to this department.

To ensure that maintenance services are readily available and accessible to the users in NEU, we have at the moment two instrumentation laboratories allocated solely for maintenance activities. These laboratories have been well equipped with all the necessary testing and diagnostic instruments, tools for repair and servicing.

At present we have about 18 technical personnels comprising of 3 Engineers, two Technical Assistants and 12 Technicians with an average experience of about 4 years in maintenance activities. With our own service facilities, we will be less dependent on the services of the supplier. Many breakdown can be attended to promptly and remedied quickly. Downtime on instruments should be much less thereby allowing for more effective utilisation of NEU instruments.

Other than instruments from NEU, maintenance services are also given to other institutions not only to the government agencies but to the private sectors as well. Request for maintenance service may be made by contacting the NEU's Customer Service Unit or directly to this department.

Our corrective maintenance services covers the following types of instrument:-

- i. Nuclear instruments e.g LSC, gamma counter, MCA, survey meter, etc.
- ii. Test instruments e.g oscilloscopes, multimeter, function generator, etc.
- iii. Analytical instruments e.g pH meter, Oxygen Analyser, Spectrometer, etc.
- iv. Power Supply.
- v. And other scientific instrument.

On the whole, instruments sent for maintenance could be repaired with the exception of a few delays due to the non-availability of service manuals/circuit diagrams and the problem of getting suitable replacement for spare parts.

To ensure reproductibility in results, all instruments after repair are calibrated using the manufacturers service manuals as reference. Calibration work is also undertaken whenever it is requested by a user.

Appendix 1, 2a and 2b show the number of instruments from the NEU and outside institutions repaired by the maintenance unit from 1982 to July 1987.

### 2.2.3 Preventive Maintenance

Preventive maintenance is often neglected especially in developing countries. As such, high costs are incurred in corrective maintenance as a result of severe damage to instrument caused by lack of preventive maintenance.

To ensure this maintenance cost and thus improve equipment reliability, NEU has developed a computerised data base system for scheduling and planning of preventive maintenance activities. This method/program is called

'Computerised Management for Preventive Maintenance' (CMPM).

This program has been developed with a few objective in mind. Besides management of preventive maintenance it provides inventory of laboratory instruments, spare parts inventory for these instruments and also repair record keeping for the instruments. The management provides scheduling/rescheduling of the jobs for preventive maintenance and recording of observations during the execution of preventive maintenance. The provision for questionnaire preparation regarding measurement and execution of preventive maintenance for each instrument is also given. All these facilities provided by the program can be categorised into four groups:-

- i. Information/Data collection.
- ii. Information/Data search, edit, delete or look.
- iii. Preventive maintenance task scheduling/rescheduling.
- iv. Activity analysis and reporting.

#### 2.2.3.1 Information/Data Collection

All the information regarding instruments is collected with reference to tag number for each instrument. The tag number is a unique number for each instrument assigned by the program on entry of the name of the instrument. This number is unalterable once the instrument record is entered.

2.2.3.1.a Instrument grouping and tag number generation.

The instruments handled by this program have been divided in ten different groups. Each group is divided into nine types. This grouping of instruments is shown in appendix 3. The tag number consists of four digits (GTNN).

The first digit (G) is assigned as the group to which the instruments belongs (0 G 9).

The second digit (T) is assigned as the type to which it belongs in that group (1 T 9).

The last two digits (NN) represent how many instruments of the same type have been entered in the system (01 NN 99).

As an example Multichannel Analysers (MCAs) from two different companies e.g Canberra series 40 MCA and ND 76 MCA if entered will be assigned 3501 and 3502 respectively as the tag number. The first two digits in both cases are the same because they are fifth type in the third group, but the last two digits are 01 and 02 respectively because Canberra series 40 MCA is the first MCA entered where as ND 76 is the second in the system. Obviously, the third MCA if entered will have a tag number 3503.

Now all subsequent information as regards to these instruments will always be stored with reference to these tag numbers. The assignment of the tag number is automatically done by the program as you select and enter the name of the instrument in the system.

Two types of information can be entered for the instrument as:-

- i. Instrument inventory information including spares.
- ii. Instrument history record.



#### 2.2.3.2 Information/Data Search, Edit, Delete or Look.

These four functions, SEARCH, EDIT, DELETE and LOOK instrument information are very useful to change the instrument information as and when required. All four functions are complementary to each other. The detailed procedure for these functions is shown in appendix 4a, 4b, 4c.

#### 2.2.3.3 PREVENTIVE MAINTENANCE TASK SCHEDULING AND RESCHEDULING

Distribution of tasks for preventive maintenance is performed by the program under scheduling or rescheduling. This is done with the help of tag number of the instrument. The detailed procedure for these functions is shown in appendix 5a.

#### 2.2.3.4 ACTIVITY ANALYSIS AND REPORTING

The program provides analysis of activity through various kinds of reports and graphs. The complete program is menu driven and self explanatory. The menu gives information on the kind of entry required. The program assumes no knowledge of dBase III or any programming language on the part of the user. The detailed procedure for these functions is shown in appendix 6a, 6b, 6c, 6d, 6e.

This preventive maintenance programme has been implemented since January this year which cover all instrument available in the NEU.

### 2.3 INSTRUMENT DEVELOPMENT

With the expertise gained through repair of instrument, and in the interests of economy and development of local capability in nuclear instrument design and manufacture, the NEU decided to fabricate locally some instruments needed for research applications and training.

As of 1986, the NEU has already fabricated close to 80 nuclear instruments used in the NEU research laboratories and for training.

Research, design and development of instruments cannot be achieved without the availability of research engineers and technicians trained and experienced in this field. There are 5 engineers and 5 technicians who are currently working in this field.

Two instrumentation laboratories have been dedicated for this purpose. The laboratories are equipped with test instruments and necessary tools to carry out the development work.

With spectacular advances in microprocessor technology, today more and more nuclear instruments are microprocessor based and therefore the use of microprocessor in the design of instrumentation cannot be avoided. It simplifies design and reduces components and development cost significantly.

Keeping this trend in view, the development of microprocessor based/computer based nuclear instrument has been undertaken by this unit.

For the microprocessor based project, a complete universal development system is available. The system is based on a VAX 11/730 minicomputer with in circuit emulators for supporting Z-80 and 8085 microprocessors. Software to that effect were also purchased.

Instruments developed during the period of 1984 to December 1986 are shown in appendix 7.

Efforts are being continued to develop more instruments so that a complete range of instruments of different specifications required for research activities and training are available in NEU.

Projects in progress are:-

- i. Microbased gamma analyser.
- ii. LSC simulation.
- iii. Permittivity meter.
- iv. Terminal server.
- v. Temperature control for Co-60.
- vi. X-ray viewer.
- vii. Public Address System for NEU exhibition room.
- viii Nucleonic Level Gauge.
- ix. Input-output (I/O) board.
- x. Warning light and interlocking system for X-ray machine.

#### 2.4 TECHNICAL ADVICE

Another service which the I & C department has been contributing is the technical advice program to assists scientists. The program includes:-

- i. advise on proper laboratory environment regarding humidity, temperature and power conditioning device.
- ii. advise on proper daily care and quality control of nuclear instruments.

iii. advise on technical specifications for tender preparation.

## 2.5 TRAINING

Lack of well trained maintenance personnels is now becoming one of the most important problems that hampered the maintenance efficiency at many institutions in Malaysia. To solve this problem training is realized as one of the realistic solution.

To keep instrument properly utilized it is realised that there are 3 categories of personnel involved in the running of a machine. They are users, operators and maintenance technicians. The three interact with one another. Therefore, training programmes should be prepared for all the three categories.

The training courses conducted by I & C department can be catogerised into two groups:-

- i. in-house training for NEU maintenance staff.
- ii. training of personnels not working for NEU.

### 2.5.1 IN-HOUSE TRAINING FOR NEU MAINTENANCE PERSONNEL.

Whether it is for repair and maintenance service or for design and development, it is obvious that unless we have trained technical personnels neither of the two activities are possible.

I & C department has always recognised the value of training for maintenance personnel. If more people know about maintenance and quality control, then more people will be aware of the necessity of maintenance and quality control for producing better work quality. Therefore, training is an essential part for effective service support.

In this regard, the efficiency of the service personnels is increased and their knowledge about instrument servicing updated through training either in house or their placement for training in other research institutes overseas. The overseas training is mostly supported by the IAEA, under its regular technical assistance programme. Such a training usually extends over a period of 6 months or less.

In the I & C department itself, a weekly seminar and lecture on related subject of interest is given to all maintenance work personnels. This will foster their confidence in doing maintenance work. It is to be noted that this weekly internal seminar/lectures have been going on for the last 4 years.

Also, weekly . montly case history discussion is also organised for the technical personnels, where repair problems and their solution are discussed.

For newly recruited staffs, they are given a basic training course. The course covers the topics of Basic Nuclear Electronics which include Radiation detection, Nuclear Instrumentation and Nuclear Counting System. After each lectures, the staffs are required to do some practicals on that particular topics.

The objective of this training course is to familiarize the recruits with nuclear electronic instrumentation, tools and techniques, necessary for doing repair work.

Adhoc training, under which the techniques and methods of servicing instrument are explained while the instruments are actually repaired, has been imparted to inexperienced engineers and technicians.

2.5.2 TRAINING OF PERSONNEL NOT ENGAGED TO NEU.

2.5.2 a Short duration courses.

From the survey conducted by NEU in late 1979, it was reported that most institutions in Malaysia were facing the lack of well trained technical personnel to cater for maintenance activities.

Most of nuclear instruments used by these institutions were not properly maintained due to the lack of knowledge and skills of the maintenance personnel. The situation led to reduced duration of use of the instrument and increased costs in term of repairs to damage instrument.

It was recognised that the ability to handle the instrument properly was very important to minimise malfunction and breakdown of instrument and the life time extended.

For these reasons, NEU has conducted several courses in nuclear instrumentation maintenance since 1980.

A six weeks first national training course on Nuclear Instrument Maintenance was held in 1980. About 35 technicians including laboratory assistants from various institutions in Malaysia participated in this course. The course aimed at increasing the knowledge of the participants on the principle of nuclear electronic instrumentation and know how as well as skills to execute maintenance.

A training course on Nuclear Electronics was organised by NEU from 2-14 November this year. The purpose of the course was to train technicians in the fundamental principles of nuclear electronic and instrumentation. The course took account of recent developments in electronics, integrated circuit techniques, nuclear radiation detectors and measuring

techniques, as well as design, utilization, maintenance and repair of nuclear instrumentation. About 20 participants from various institutions in Malaysia participated in this course. The course was designed such that 60% of the total time of the course were spent on practicals and 40% on lectures and discussion.

It has been decided that training courses on electronics and nuclear instrumentation will be continuously conducted and included in NEU's long term planning.

A list of training courses conducted by NEU in nuclear instrumentation maintenance since 1980 is shown in appendix 8.

These training activities gained much appreciation from the management in NEU who gave it effective support.

#### 2.5.2 b On-Job Training

In this scheme, any organisation can send its engineers and technicians to NEU, where they work on different jobs with technicians of the department. In this process they acquire both practical and theoretical knowledge on instrument maintenance and service.

#### 2.5.2 c Industrial Training For University Students

NEU also provides industrial training for University Students during their vacation. This is to expose the students to real working condition, understanding about nuclear instrumentation and also human relations.

From 1984 to July 1987 about 15 students had been given an industrial training.

## 2.6 STOCK OF SPARE PARTS

Spare parts remain an essential link in the chain of corrective action, and their absence inevitably causes unduly long downtime of instrument.

The more spare parts that are in stock, the more convenient it will be for those who are responsible for maintenance. However, the cost incurred for storing these spare parts will be higher. Therefore, efforts are made by our electronic store to stock the commonly used spare parts or parts that are likely to fail more often.

At present, about 30,000 components are available in our electronic store and spares from various manufacturers are stocked separately. The components in stock include IC's, resistors, capacitors, fuses, batteries, sensors, transformers, etc.

It is difficult to keep track of such a large number of components if it is done manually. Therefore, a computerised stock inventory system is under installation at present.

This system is expected to facilitate the process of purchasing and locating of spare parts. Stock level is always maintained and updated. Under this system, the components are categorised into different codes consisting of main codes, sub-codes and the exact-codes. Through these codes, the user can easily specify the components which need to be ordered.

## 2.7 PRINTED CIRCUIT BOARD (PCB) DESIGN

In NEU we have established our own small PCB facility to support the instrumentation development activity. At present, we are capable in producing single or double sided PCB with no through hole plating.

A personal computer having a software package for PCB design has been used in drawing the PCB artwork. The artwork can now



be achieved in significantly shorter time scale with less errors than doing manually by hand.

### 3.0 CONCLUSION

Due to the complexity and high cost of the nuclear instrumentation, effective maintenance is essential if the investment in instrument is not to be a major waste.

Instrumentation plays an important role in the operation and research carried out in a particular agency. With instruments that are not in good working conditions, research activities will be impeded.

It is the intention of NEU to build up a strong maintenance unit to look after the large number of instruments available in the NEU and to render services to other government agencies as well as to the private sectors.

Appendix 1

Number of instruments from NEU repaired by the Maintenance Unit from 1982 to July 1987.

Year	No of instruments
1982	38
1983	20
1984	71
1985	132
1986	200
1987	60

Repair and maintenance service rendered to outside institutions from 1982 to July 1987.

Appendix 2a

Name of Institutions	No of instruments repaired					
	1982	1983	1984	1985	1986	1987
1. Universiti Kebangsaan Malaysia	9	3	1	14	18	1
2. Universiti Teknologi Malaysia	6	1	7	1	46	2
3. Universiti Pertanian Malaysia	3	1	5	1	9	-
4. MARDI	3	5	-	2	6	2
5. SIRIM	-	-	-	-	1	2
6. General Hospital Kuala Lumpur	-	-	-	-	-	3
7. United Inspection Ser. Sdn Bhd	-	-	-	2	3	2
8. RRI	-	-	-	-	1	1
9. Independent Testing Co.	-	-	-	-	1	-
10. Geological Survey Dept.	-	-	-	-	10	-
11. Velosi (M) Sdn Bhd	-	-	-	8	2	2
12. Harris Semi Conductor Co.	-	-	-	-	1	-
13. Inter Marine Supply & Equip. Co.	-	-	-	-	1	-
14. Song Sing Industrial Products	-	-	-	-	1	-

Repair and maintenance service rendered to outside institutions from 1982 to July 1987.

Appendix 2b

Name of Institutions	No of instruments repaired					
	1982	1983	1984	1985	1986	1987
15. NTI (M) Sdn Bhd	-	-	-	-	-	2
16. Inspection & Marketing Services	-	-	-	-	-	2
17. Advanced Micro Devices	-	-	-	-	-	2
18. Inspection & Certif. (M) Sdn Bhd	-	-	-	-	-	2
19. Ind. Testing & Eng. Ins. Sdn Bhd	-	-	-	-	-	1
20. National Semi Conductor (M) Sdn Bhd	-	-	-	-	-	1
21. Malaysian Airline System	-	-	-	-	-	1
22. Asian Rare Earth	-	-	-	-	-	1
23. LPTA	-	-	-	-	-	2
24. FRIM	-	-	-	-	-	1
25. Ansel (M) Sdn Bhd	-	-	-	-	-	1

- |                              |                             |                          |                                |
|------------------------------|-----------------------------|--------------------------|--------------------------------|
| 0. <u>NUCLEAR SAFETY</u>     | 10. <u>PRESERVATION</u>     | 20. <u>STANDARDS</u>     | 30. <u>NUCLEAR INSTRUMENTS</u> |
| 1. ALARM/NUCL. FIRE          | 11. SAFETY CIRC./SW.        | 21. RADIATION SOURCE     | 31. BIN, D.C. SUPPLY           |
| 2. POCKET DOSEMETER          | 12. LAB. ENVIRONMENT        | 22. DOSEMETER            | 32. PRE/LIN/LOG AMP.           |
| 3. GAMMA SURVEY M.           | 13. DEHUM./AIR-CON          | 23. DOSE CALIBRATOR      | 33. SCALER/TIMER               |
| 4. ALPHA/BETA CONT.          | 14. D.O. REL. VARIST        | 24. D.C. SOURCE          | 34. SCA/DD                     |
| 5. NEUTRON DOSE M.           | 15. CVT                     | 25. D.C. METER, AVO      | 35. MCA                        |
| 6. TLD                       | 16. NETWORK/GROUND          | 26. A.C. SOURCE          | 36. MCA. + COMPUTER            |
| 7. AIR/LIQ MONITOR           | 17. COVER/DOOR/WIND.        | 27. A.C. METER, AVO      | 37. SAMPLE CHANGER             |
| 8. BODY/HAND/FOOT M.         | 18. EMERGENCY POWER         | 28. PREC. PULSE GEN.     | 38. NIM/CAMAC MODUL            |
| 9. DECONTAM. KIT             | 19. FIRST AID KIT           | 29. OTHER                | 39. OTHER                      |
| <br>                         |                             |                          |                                |
| 40. <u>RECORDERS</u>         | 50. <u>ANALYTICAL INST.</u> | 60. <u>REPAIR INSTR.</u> | 70. <u>AUXILIARY EQUIP.</u>    |
| 41. CHART, PEN/THERMO        | 51. PH METER                | 61. AVO METER            | 71. OVEN/HOT PLATE             |
| 42. XY PLOTTER               | 52. GAS CHROMATOGR.         | 62. DIG. MULTI METER     | 72. DEWAR                      |
| 43. PRINTER/TELETYPE         | 53. LIQ. CHROMATOGR.        | 63. FUNCTION GEN.        | 73. CENTRIFUGE                 |
| 44. PAPER TAPE PUNCH         | 54. OXYGEN ANALYSER         | 64. OSCILLOSCOPE         | 74. REFRIGERATOR               |
| 45. MAGNETIC TAPE            | 55. HYDROGEN ANAL.          | 65. NUC. PULSE GEN.      | 75. VACUUM PUMP                |
| 46. VIDEO                    | 56. DIFF. THERMAL A.        | 66. ELECTRIC TOOLS       | 76. COMPRESSOR                 |
| 47. PHOTOGRAPHIC             | 57. SPECTROMETER            | 67. DIGITAL PROBES       | 77. HOT WATER BATH             |
| 48. RH/T AND V               | 58. COLORIMETER             | 68. H.V TEST UNIT        | 78. BALANCE                    |
| 49. OTHER                    | 59. OTHER                   | 69. OTHER                | 79. OTHER                      |
| <br>                         |                             |                          |                                |
| 80. <u>NUCLEAR DETECTORS</u> | 90. <u>SPECIAL SYSTEM</u>   |                          |                                |
| 81. ION CHAMBER              | 91. REACTOR CONTROL         |                          |                                |
| 82. PROP. COUNTER            | 92. ACCELERATOR             |                          |                                |
| 83. G.M. COUNTER             | 93. COMPUTER                |                          |                                |
| 84. LIQ. SCINT. DET.         | 94. TELECOM                 |                          |                                |
| 85. SOLID SCINT. DET.        | 95. NUCL. IMAGING           |                          |                                |
| 86. GELI/SILI DET.           | 96. NUC. MED. INSTR.        |                          |                                |
| 87. INTR. GE DET.            | 97. GEOPHYSICAL.            |                          |                                |
| 88. SURFACE BARRIER          | 98. PROCESS CONTROL         |                          |                                |
| 89. OTHER                    | 99. OTHER                   |                          |                                |

CMPM FUNCTION MENU

<u>NO</u>	<u>FUNCTION</u>
0	ENTER INSTRUMENT INFORMATION
1	SCHEDULE/RESCHEDULE INSTRUMENTS FOR QC+PM
2	EDIT/DELETE/LOOK INSTRUMENT INFORMATION
3	EDIT PARAMETERS OF SCHEDULE FOR QC+PM (LOCATION, PERSON)
4	EDIT/ENTER QUESTION FORM FOR PREVENTIVE MAINTENANCE
5	ENTER EXECUTED FINDINGS OF PREVENTIVE MAINTENANCE & QC
6	ENTER REPAIR DETAILS
7	ENTER/UPDATE/SEARCH SPARE PARTS
8	INFORMATION SEARCH
9	GENERATE REPORTS
G	GRAPHICS REPRESENTATION
S	SUMMARY OF PREVENTIVE MAINTENANCE
I	INITIALISE CMPM DATABASE
X	EXIT FROM PROGRAM

ENTER NUMBER AS REQUIRED FUNCTION :

TAG NUMEBER:  
NAME OF THE INSTRUMENT:  
MODEL NUMBER:  
SERIAL NUMBER:  
INVENTORY NUMBER:  
YEAR OF MANUFACTURER:  
NAME OF MANUFACTURER:  
ADDRESS OF MANUFACTURER:  
TELEX NUMBER OF MANUFACTURER:  
PHONE NO. OF MANUFACTURER:  
NAME OF THE SUPPLIER:  
ADDRESS OF SUPPLIER:  
PHONE NO. OF SUPPLIER:  
PRICE IN FOREIGN CURRENCY:  
PRICE IN LOCAL CURRENCY:  
DATE OF ARRIVAL:  
DATE OF COMMISSIONING:  
END OF WARRENTY:  
REPAIR CONTRACT:  
LOCATION OF THE INSTRUMENT:  
MAIN USER OF THE INSTRUMENT:

DO YOU WANT MORE INFORMATION? (Y/N):

MAIN OPERATOR OF THE INSTRUMENT:  
PHONE NO. OF THE USER:  
IS OPERATING MANUAL AVAILABLE?:  
IS SERVICE MANUAL AVAILABLE?:  
IS CIRCUIT DIAGRAM AVAILABLE?:  
LOCATION OF THE MANUAL:  
IS PARTS LIST AVAILABLE?:  
ACCESSORIES LIST:  
POWER CONSUMPTION WATT/VOLT-AMP:  
RANGE OF OPERATING VOLTAGE:  
RANGE OF RELATIVE HUMIDITY:  
RANGE OF OEPARING TEMPERATURE:  
TYPE OF STABILIZER USED:  
TYPE & CAPACITY OF DROP OUT RELAY:  
NAME OF PREVENTIVE MAINTENANCE HEAD:  
PHONE NO. OF PM HEAD:  
LIST OF SPECIAL TEST EQUIPMENT:  
SPARES AVAILABLE?:  
LIST OF ASSOCIATED EQUIPMENTS:  
REFERENCE FOR PM PROCEDURE:

DO YOU WANT MORE INFORMATION? (Y/N):

<u>NO</u>	<u>FUNCTION</u>	<u>TYPE</u>
E	EDIT INSTRUMENT INFORMATION	
D	DELETE INSTRUMENT RECORD	
L	LOOK FOR INSTRUMENT INFORMATION	
R	RETURN TO THE MAINMENU	

ENTER LETTER AS REQUIRED FUNCTION TYPE:

SEARCH RECORDS USING ANY OF THE FOLLOWING INFORMATION

<u>KEY</u>	<u>INFORMATION</u>
A	INSTRUMENT NAME
B	INSTRUMENT MODEL NUMBER
C	INSTRUMENT SERIAL NUMBER
D	INSTRUMENT MANUFACTURER
E	INSTRUMENT SUPPLIER
F	INSTRUMENT INVENTORY NUMBER
G	INSTRUMENT ARRIVAL DATE
H	INSTRUMENT LOCATION
I	INSTRUMENT USER NAME
J	INSTRUMENT LEVEL-2 PM PERSON
K	INSTRUMENT TAG NUMBER
L	RETURN TO MAINMENU

ENTER ANY ONE KEY FOR REQUIRED SEARCH:



<u>KEY</u>	<u>FUNCTION</u>
S	SCHEDULE QC-PM FOR SET OF INSTRUMENTS
R	RESCHEDULE QC-PM FOR SET OF INSTRUMENTS
M	BACK TO MAINMENU

ENTER CORRECT KEY FOR THE REQUIRED FUNCTION:

CHOOSE ONE CONDITION FOR SCHEDULING

<u>KEY</u>	<u>CONDITION</u>
1	SCHEDULE ALL NEWLY ENTERED INSTRUMENTS
2	SCHEDULE ONLY SELECTED GROUP OF INSTRUMENTS
3	SCHEDULE INSTRUMENTS AT SELECTED LOCATION
4	SCHEDULE INSTRUMENTS MAINTENED BY SELECTED PERSON
5	SCHEDULE INSTRUMENTS FOR SELECTED GROUP AND LOCATION
6	SCHEDULE INSTRUMENTS FOR SELECTED GROUP AND PERSON
7	SCHEDULE INSTRUMENTS FOR SELECTED LOCATION AND PERSON
8	SCHEDULE INSTRUMENTS FOR SELECTED GROUP, LOCATION & PERSON
R	RETURN TO THE MAINMENU

ENTER THE PROPER KEY FOR YOUR CHOICE:

CHOOSE ONE CONDITION FOR RESCHEDULING

<u>KEY</u>	<u>CONDITION</u>
1	RESCHEDULE ALL ENTERED INSTRUMENTS
2	RESCHEDULE ONLY SELECTED GROUP OF INSTRUMENTS
3	RESCHEDULE INSTRUMENTS AT SELECTED LOCATION
4	RESCHEDULE INSTRUMENTS MAINTENED BY SELECTED PERSON
5	RESCHEDULE INSTRUMENTS FOR SELECTED GROUP AND LOCATION
6	RESCHEDULE INSTRUMENTS FOR SELECTED GROUP AND PERSON
7	RESCHEDULE INSTRUMENTS FOR SELECTED LOCATION AND PERSON
8	RESCHEDULE INSTRUMENTS FOR SELECTED GROUP, LOCATION & PERSON
R	RETURN TO THE MAINMENU

ENTER THE PROPER KEY FOR YOUR CHOICE:

<u>NO</u>	<u>REPORT TYPE</u>
0	WORK LOAD PER PM-PERSON FOR LEVEL2 PER YEAR
1	WORK LOAD PER PM-PERSON FOR LEVEL3 PER YEAR
2	LIST OF GOOD/BAD INSTRUMENTS
3	LIST INSTRUMENT NAME, PM-PERSON-LV2, PM-PERSON-LV3
4	QUESTION FORM FOR REPORTING EXECUTED LEVEL-2 PM
5	JOB LIST FOR LEVEL-2 PERSONS FOR REQUIRED WEEK
6	INSTRUMENT'S HISTORY OF LEVEL-2 PM EXECUTED
7	REPAIR HISTORY OF A SELECTED INSTRUMENT
8	LIST OF SPARE PARTS FOR A SELECTED INSTRUMENT
9	LIST OF PERSONS DOING LEVEL-2 JOBS FOR REQUIRED WEEK
P	LIST OF EQUIPMENT FOR A WEEK
R	RETURN TO THE MAINMENU

ENTER NUMBER OF REQUIRED REPORT:

<u>NO</u>	<u>TYPE OF GRAPH</u>
1	TOTAL TIME FOR LEVEL-2 PER INSTRUMENT PER YEAR
2	TOTAL TIME FOR LEVEL-2 PER INSTRUMENT PER YEAR
3	NO. OF INSTRUMENTS IN EACH GROUP
4	YEARLY DISTRIBUTION OF WORK LOAD PER PERSON - FOR LV2
5	YEARLY DISTRIBUTION OF WORK LOAD PER PERSON - FOR LV3
6	WEEKLY LOAD OVER A YEAR FOR LEVEL 2 MAINTENANCE
7	WEEKLY LOAD OVER A YEAR FOR LEVEL 3 MAINTENANCE
8	INSTRUMENTS/WEEK FOR PERSON DOING LEVEL 2
9	NUMBER OF INSTRUMENTS PER LOCATION
R	RETURN TO THE MAINMENU

ENTER NUMBER AS REQUIRED GRAHP TYPE:

PM HISTORY OF LEVEL - 2

TAG NUMBER : 3501

INSTRUMENT NAME : ND66-MCA

PERFORMED BY : SARIZAH

<u>DATE</u>	<u>VTG 1</u>	<u>RPL 1</u>	<u>VTG 2</u>	<u>RPL 2</u>	<u>VTG 3</u>	<u>RPL 3</u>	<u>VTG 4</u>	<u>RPL 4</u>	<u>VTG 5</u>	<u>RPL 5</u>
08/01/85	+ 4.96	12	+11.87	200	+23.97	10	-12.04	23	-23.88	234
01/01/83	+ 4.99	10	+12.03	5	+23.88	50	-11.77	100	-23.56	150
09/15/86	+ 4.97	200	+11.88	27	+24.04	10	-11.65	270	-24.10	10

VTG = VOLTAGE (V), RPL = RIPPLE (mV)

<u>DATE</u>	<u>PAR1</u>	<u>PAR2</u>	<u>PAR3</u>	<u>PAR4</u>	<u>PAR5</u>	<u>PAR6</u>	<u>REMARKS</u>
08/01/85	667	234,234	411	N	Y	N	NIL
01/01/83	666	3000,3000	410	Y	N	N	ROOM HUMID
09/15/86	665	8888,8888	409	Y	Y	N	ROOM WAS HUMID

PAR1 : NOTE CS-137 PEAK FOR SETTINGS IN PM REFERENCE ?

PAR2 : NOTE COUNTS IN CHANNEL 102 & 3099 AFTER MEM TEST ?

PAR3 : OFFSET BY 256 CHANNEL & NOTE CH. NO. OF Q1 ?

PAR4 : IS HV CLEANED ?

PAR5 : IS FAN FILTER CLEANED ?

PAR6 : ANY LOOSE CONTROLS TIGHTEN ?

INSTRUMENT REPAIR HISTORY

INSTRUMENT NAME:ND66-MCA            TAG-NUMBER            3501

REPAIR NUMBER: 01/05/83  
DATE OF FAULT: UNKNOWN  
CAUSE OF FAULT:ADC FAILURE  
TYPE OF FAULT: NO PROPER STORAGE  
MALFUNCTION TYPE 1:  
MALFUNCTION TYPE 2:  
MALFUNCTION TYPE 3:  
FAULT DIAGNOSIED BY: RAMZAH  
REPAIRED BY: KAMARUDIN  
SYSTEM CONDITION: OK

PARTS REPLACED

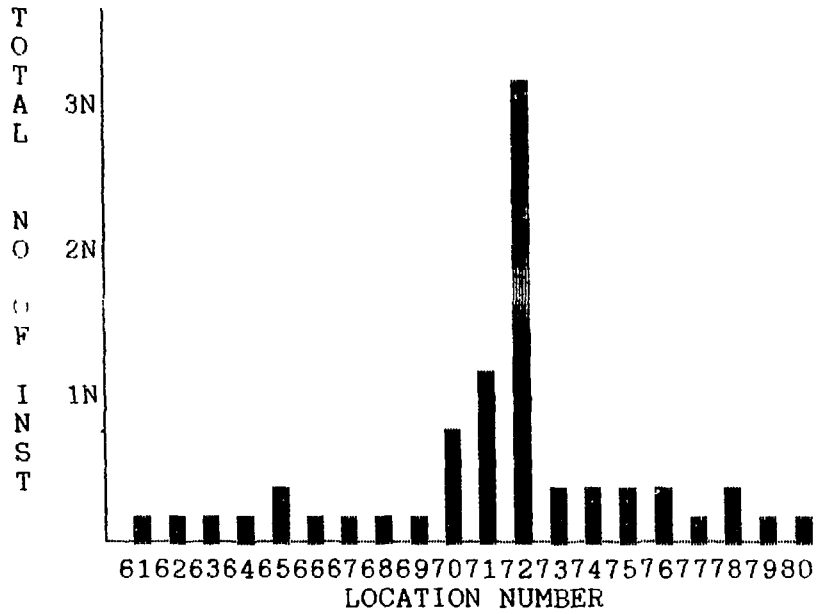
PART NO	PART NAME	TYPE NO	QTY
1: ADC-21-1	TRANSISTO	EC 234	2
2: ADC-22-2	IC	SN 74LS354	2
3:			0
4:			0

REPAIR NUMBER: 2  
DATE OF FAULT: 01/01/86  
CAUSE OF FAULT: BAD MAINS  
TYPE OF FAULT: LV SUPPLY FAILURE  
MALFUNCTION TYPE 1: NO ACQUISITION  
MALFUNCTION TYPE 2:  
MALFUNCTION TYPE 3:  
FAULT DIAGNOSIED BY: NAJIB  
REPAIRED BY: ROSLIN  
SYSTEM CONDITION: OK

PARTS REPLACED

PART NO	PART NAME	TYPE NO	QTY
1: LV-C-1234	CONDENSOR	ELECTROLYTIC	2
2: LV-IC-1256	REGULATOR	723	2
3:			0
4:			0

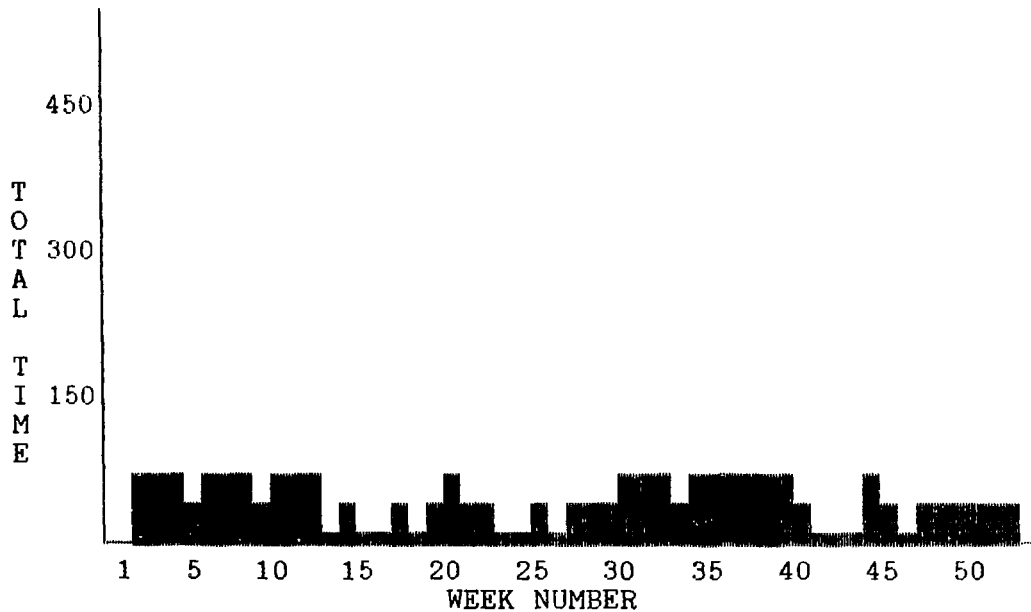
(N = 69) NUMBER OF INSTRUMENTS PER LOCATION



- 61 C 009
- 62 C 010
- 63 C 011
- 64 C 012
- 65 C 013
- 66 C 014
- 67 C 015
- 68 C 016
- 69 C 018
- 70 C 101
- 71 C 102
- 72 C 103
- 73 C 104
- 74 C 105
- 75 C 106
- 76 C 107
- 77 C 110
- 78 C 111
- 79 C 112
- 80 C 113

PRESS Shift-PrtSc TO GET HARD COPY OR ANY KEY TO NEXT GRAPH

WEEKLY LOAD FOR KAMARUDIN DOING LEVEL 2 MAINTENANCE



PRESS Shift-PrtSc TO GET HARD COPY OR ANY KEY TO CONTINUE

Instruments Developed by NEU from 1984 to 1986

Appendix 7

1984	1985	1986
1. Radiation Area Monitor - Unit 2	1. Microbased IC tester	1. Hand and Foot Monitor
2. Pulser	2. Z-80 mother board	2. Drop out relay with delayed switch - on and reset
3. Single Channel Analyser	3. Radiation Area Monitor - Unit II and III	3. Universal Counter
4. Sampel Changer	4. Timer 0-9.9s	4. DC Amplifier
5. Spectroscopy Amplifier	5. Nickel Cadmium Battery Charger	5. 3A,5V power supply
6. High Voltage Power Supply	6. Audio Amplifier	6. Timer for x-ray machine
7. Nim bin power supply +6V,5A	7. Timer 0-9000.00 sec	7. Portable Survey Meter
8. Counter/Timer	8. Power Supply +5V,5A	8. Floor Monitor
9. Temp. Control for Muffle Furnace	9. G.M Counter/Timer-10 units	9. Ultrasonic Alarm System
10. 12V,5A power supply	10. 6 decade counter timer	10. Intercom system
11. 5V,1A power supply	11. RS 232 to RS 422 Converter	11. Battery charger 0.300 mA, 60V
12. Stack Monitor	12. Interfacing between SD-kit to NEC microcomputer	12. Pulser
13. Timer (9000.00 Sec)		
14. Control lamp for x-ray room		
15. PUSPATI Safety Public Address System		

Training Courses Conducted by NEU in  
Nuclear Instrumentation Maintenance

Name of Training Course/ Workshop	Duration/Year	No of participant
i. Training Course on Nuclear Instruments Maintenance.	6 weeks (1980)	35
ii. National Workshop on Quality Assurance in the use of Nuclear Medicine Instruments.	4 days (1982)	35
iii. Training Course on Nuclear Instruments Maintenance.	4 weeks (1982)	20
iv. Training Course on Nuclear Instruments Maintenance.	3 weeks (1985)	20
v. Training Course on Basic Maintenance and Operation of Liquid Scintillation Counter.	3 days (1986)	20
vi. Training Course on Basic Maintenance and Operation of Gamma Counter.	3 days (1986)	20
vii. Training Course on Nuclear Electronics.	2 weeks (1987)	20