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Transition from Quality Assurance Programmes to Integrated Management System in NIRR-1 Facility

N. Abubakar*, I. Yusuf, S. A. Jonah

Centre for Energy Research and Training, Ahmadu Bello University, Zaria, Nigeria

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ABSTRACT

The transition from the Quality Assurance (QA) Programmes to the Integrated Management System (IMS) was imminent in the Nigeria Research Reactor-1 (NIRR-1) from the regulatory and best practices perspectives. NIRR-1 is a Miniature Neutron Source Reactor (MNSR) with a nominal thermal power of 34 kW after its fuel was converted to Low Enriched Uranium (LEU) in 2018. The reactor has been in operation since 2004 when it was first commissioned using High Enriched Uranium (HEU) fuel. The Quality Assurance (QA) programme for NIRR-1 was first developed in 2002 before the commissioning of the reactor in 2004. Since then, several changes have occurred in the existing safety standards and national regulations. An effort was made in 2021 to draft the initial IMS programme for the NIRR-1 facility, by combining the various existing QA programmes, using the IAEA Safety Standard No. GSR Part 2 and other relevant documents for guidance. This effort required further input from experts, especially those from facilities that implemented the IMS, to help in developing a standard IMS programme for NIRR-1. In this regard, the NIRR-1 management requested the assistance of the International Atomic Energy Agency (IAEA) to facilitate the movement from the QA programmes of the various aspects of NIRR-1 to an IMS.

INTRODUCTION

The Nigeria Research Reactor-1 (NIRR-1) facility housed the Miniature Neutron Source Reactor (MNSR), which has become the first and only nuclear reactor currently in the country, operated by the Centre for Energy Research and Training (CERT), owned by the Nigeria Atomic Energy Commission (NAEC) and regulated by the Nigeria Nuclear Regulatory Authority (NNRA). It is a tank-in-pool type reactor using light water as moderator and coolant, and beryllium as reflector. The reactor has been mainly used for Neutron Activation Analysis (NAA) and as a tool for research, training and human resource development. NIRR-1 has been in operation since 2004 when it was first commissioned to operate at nominal power of 31 kW using 90.2 % High Enriched Uranium (HEU) fuel. The reactor fuel was converted to 13.0 % Low Enriched Uranium (LEU) and commissioned for the second time in 2018 attaining a nominal power of 34 kW [1].

The Quality Assurance (QA) programme for the facility was initially developed and documented in 2002 to take in to account the processes of various aspects encompassing the facility Design; Installation; Commissioning; Operation; Utilisation; Management Programme and Documentation Control; and Radiation Protection. Some of the documentations were domesticated from the vendors. A number of documents including some QA documents were updated and some new documents were produced for processes in different aspects during the NIRR-1 HEU to LEU fuel conversion programme. The lessons learned during the fuel conversion activities including the various trainings and consultation meetings have been instrumental as driving forces to the development of an Integrated Management System (IMS) in NIRR-1 post fuel conversion era. Subsequently, there were also a number of changes taking place in the existing safety standards and national regulations [2]. The development of the IMS in the facility became imminent

and necessary to comply with the recent 2021 national regulatory requirement on the safety of research reactors[2] which requires the establishment of the IMS in the facility.

This development led to the effort made to develop the initial IMS programme for NIRR-1 facility [3] by combining the existing QA programmes of various aspects using the IAEA Safety Standards [4] and other relevant documents for guidance. This effort required further assistance by means of input from experts, especially those from facilities that implemented the IMS, to help in developing a standard IMS programme for NIRR-1. In this regard, the NIRR-1 management requested the assistance of the International Atomic Energy Agency (IAEA) to facilitate the movement from the QA programmes of the various aspects in NIRR-1 to an IMS, which yielded positive response by the IAEA.

This paper discusses the development, experiences, challenges encountered, lesson learned, and the stages being followed for a successful transition from the QA programme to IMS as well as the assistance from the IAEA to the NIRR-1 facility in developing the capacity to overcome the challenges to accomplish the IMS objectives for NIRR-1.

Transition Process Development from QA to IMS Programme in NIRR-1 Facility

The transition process from QA to the IMS in NIRR-1 facility actually started in 2021 with an interim IMS programme developed by integrating various QA programmes [3] to fulfil regulatory licensing provision

with the aim of subsequent immediate review and update. The tentative schedule for the transition programme is presented in Table 1. The Table highlights the main activities and their timelines. The IMS programme for NIRR-1 facility is expected to be implemented in 2023, while the comprehensive implementation for CERT is expected to be accomplished in 2024.

In view of the demand of the tasks in revising the interim programme coupled with limited knowledge of the facility staff, the Management of CERT requested the assistance of the IAEA to facilitate the development and implementation of an IMS programme for NIRR-1. An IAEA expert mission was organised to the facility to study and review the interim IMS programme and other relevant documents, trained the IMS appointed team and provided recommendations for improvement.

The management of CERT decided to consider the implementation of IMS starting with NIRR-1 facility as an initial phase to commence the IMS programme for the entire organisation. This phase is expected to be the underpinning step towards the successful IMS programme once implemented for the entire organisation as a research reactor operating organisation. The transition programme can be highlighted and depicted in Figure 1. The transition programme was started by the Management appointing a team referred to as ‘the IMS Committee’ chaired by the director of CERT and comprising the NIRR-1 reactor manager, reactor supervisor, administrative secretary, one operator and the IMS coordinator.

Table (1): NIRR-1 IMS transition programme

S/N	Activity	Responsibility	Time line	Remark/Comment
1	Interim IMS programme integration of QA documents	CERT	March 2021	Using general provisions [4]
2	IAEA expert mission on IMS, submission and review of report	Experts / IAEA	August 2022	Mission conducted in June 2022 & report submitted to IAEA for approval
3	Review of the report of the IAEA expert mission by facility	CERT	September 2022	
4	Training of IMS coordinator and assistants	IAEA	November 2022	Scientific visits of other similar reactor facilities
5	IMS manual and implementation for NIRR-1 facility	CERT	April 2023	Duration of six months
6	Review and Verification of the IMS for CERT	CERT	December 2023	Duration of seven months
7	Full Implementation	CERT	2024	

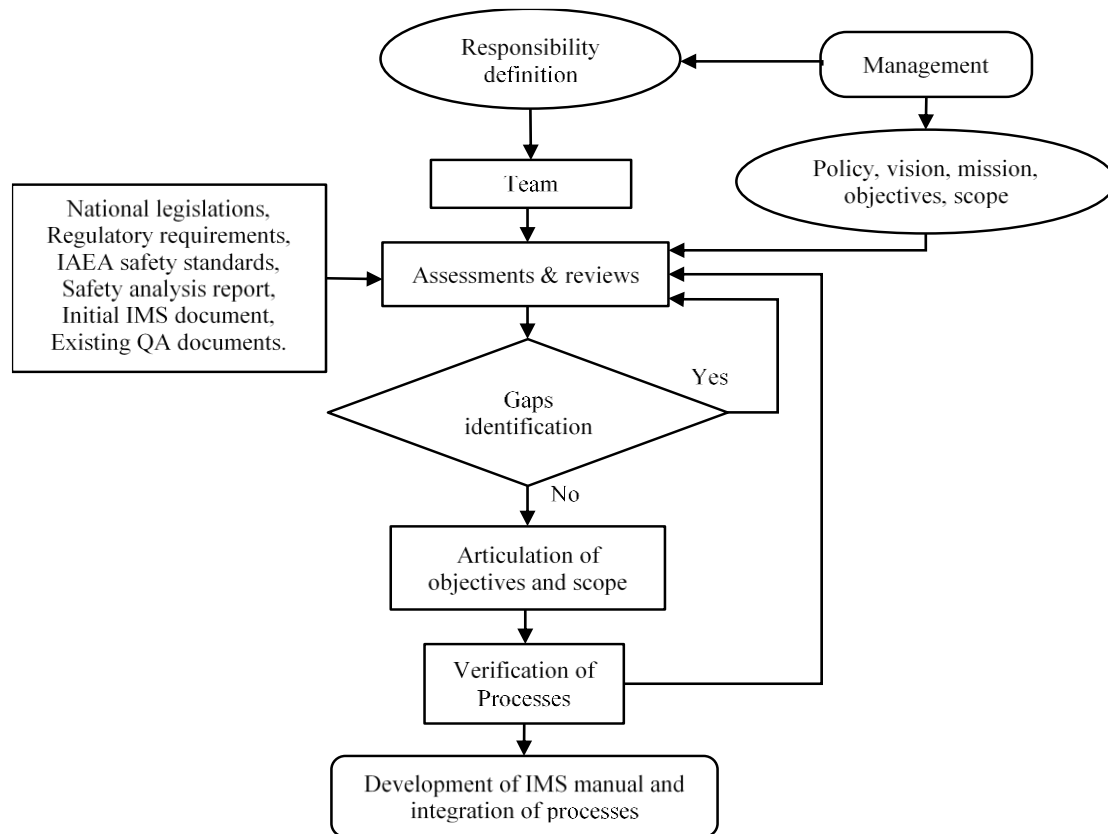


Fig. (1): Development of the IMS transition programme for NIRR-1 facility

The team reviewed the national regulatory [2] and IAEA safety standards requirements [4] [5] [6] to come up with the appropriated structure that forms a guide for the preparation of a manual of the IMS programme for NIRR-1 with the following objectives and scope:

- i. To provide the framework for effective implementation of activities of management in NIRR-1 facility relating to regulatory requirements, application of safety standards and best practice in a graded approach;
- ii. To ensure the integration of the QA aspects of NIRR-1 management for safety, security and radiation protection including health, environmental and economic aspects; and
- iii. To be applied in the implementation of the technical and administrative requirements geared toward achieving the vision and mission in line with the policy of CERT.

The scope of NIRR-1 IMS programme encompasses all activities relating to the management of safety, security, quality, environment, occupational health, and economic objectives at the NIRR-1 facility.

The assessments and reviews of the documented existing QA programmes and other relevant documents in place were carried out for their transformation into the IMS as outlined in Figure 1. The gaps identified and disparity observed during the reviews were corrected, graded and documented for rectification and articulation with the IMS structure. Operational processes were verified to be mutually integrated in a coherent manner that conveys the requirements for managing and monitoring the activities in NIRR-1 in a planned and systematic manner.

The commitment of the CERT Management, in establishing IMS policy and objectives, has paved the real step to establish the IMS, which required; the identification of all requirements in the national regulations, IAEA safety standards, and best practice; the graded approach in the contexts of the facility and in accordance with the operation license; assigning a team to plan and establish the IMS; preparation of a time based schedule with deadlines and milestones; and production of the IMS manual [5].

The development of the IMS in CERT was intended to be in three stages;

- i. Stage one: Harnessing and integrating available processes and documentations of the existing QA programmes in NIRR-1 facility;
- ii. Stage two: Integration of other processes identified in the IAEA safety standards using graded approach to produce and implement the IMS for NIRR-1; and
- iii. Stage three: Establishment of comprehensive IMS for CERT (NIRR-1 Operating Organisation) which involves integration of NIRR-1 and all other facilities.

The initial IMS document [3] was prepared for NIRR-1 facility in 2021 to meet the regulatory licensing requirements using the IAEA safety standards number GSR Part 2 [4], and this required the use of additional IAEA safety guides to reorganise the IMS document. This process concludes stage one of the transition process.

The preparation of the IMS programme manual for NIRR-1 was being organised and structured in a graded approach to meet the national regulatory requirements and the IAEA safety standards requirements for nuclear safety, nuclear security, health, environment, quality and economic aspects [7] [8]. It is also intended and envisioned to lead towards realising best practices as in the international standards. When implemented, the IMS manual will serve as a guide and basis for all processes and documentation of procedures for management, staff, contractors, students, users and visitors to manage and conduct all activities in a way that meets an excellent operational safety performance and guides in making effective decisions for continuous improvements in the facility.

Documentation of Processes

The IMS for NIRR-1 has been planned to be implemented in a graded approach, as required in the national regulation [5] and guided in the IAEA safety standards [6]. Verification of processes, as depicted in Figure 1, involves the review of activities to ensure that processes and their procedures are appropriately documented and executed in the facility consistent with the following:

- i. Regulatory requirements;
- ii. Provisions in the Safety Analysis Report (SAR);
- iii. Design requirements;

- iv. Operational Limits and Conditions (OLCs); and
- v. CERT established administrative requirements.

CERT Management insists on meeting statutory and regulatory requirements, established IMS policy and ensures that activities necessary to prevent, detect, monitor, assess and mitigate safety and security issues are being effectively performed [3].

Processes are defined and documented according to their distinct objectives within the established scope. Existing processes in the NIRR-1 facility are reviewed to identify gaps for rectification and new processes are developed to close gaps and fulfil requirements. Once a process and its activities are graded, it is then assigned an owner to be responsible for documentation through generation of procedures for the process and sub-processes, reviews and record keeping. Process documentation is portrayed in Figure 2 which shows the pathway followed for process verification. Subsequently, in the event a process satisfies the relevant objectives, it is documented for approval and implementation. Operations in NIRR-1 shall be based on written procedure and all documents shall be properly labelled with a reference code consisting of facility code, process code, document number, and review number as well as names and initials of developer(s), reviewer(s) and approver.

Figure 3 presents the organisational chart projected for NIRR-1 management depicting the position of the IMS coordinator linked directly to the CERT Director, which also indicates a direct link to the Senior Management. In the chart, CERT Management communicates directly with the NNRA through the Director, while Reactor Safety and Security Committee (RSSC) and Radiation Protection Advisory Committee (RPAC) are Management committees reporting to the Director. The dotted arrow points to other sections, that are not discussed here, of the organisation which have their various units under the Director. NEAC Chairman and the CERT board of Governors have their communication and reporting lines and the Director mutually reports to both. The NIRR-1 Manager operates under the Director and has communication/reporting lines with the IMS coordinator, RSSC and RPAC to facilitate general discussions and clarifications of various issues that may emanate occasionally. The reactor operational activities are carried out under the direct supervision of the reactor supervisor who reports to the NIRR-1 Manager.

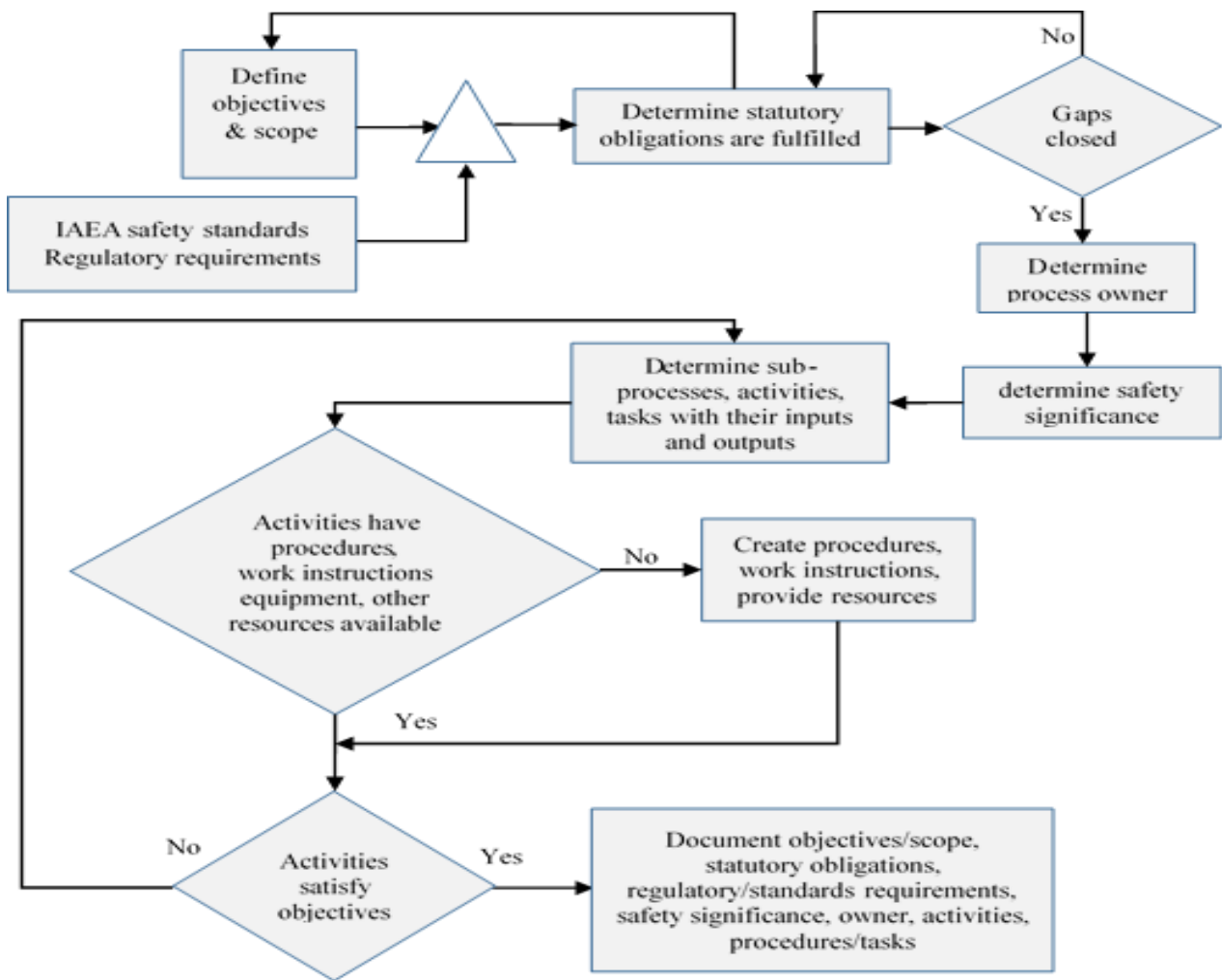


Fig. (2): Process documentation in the IMS manual

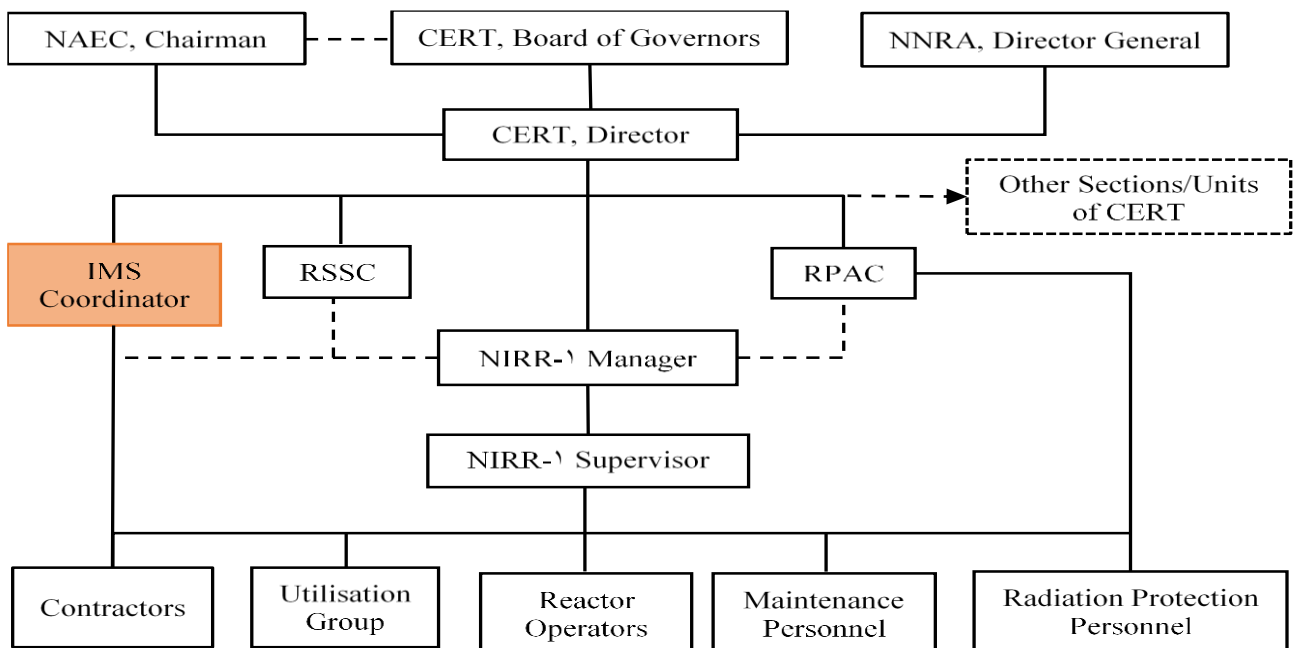


Fig. (3): Proposed organizational structure for NIRR-1 Management Integrating IMS Coordinator

Experiences and Challenges

Although the IMS programme is currently on track to full implementation in NIRR-1 facility, a number of experiences have been acquired by the NIRR-1 facility Management and staff in the course of the transition process. These involves but not limited to the following:

- Basic knowledge of the IMS including the evolution from QA to quality management to IMS, as well as the fundamental components and requirements for migration to an IMS programme.
- Review of processes and proper documentation keeps revealing the gaps to be filled for effective implementation of processes and enhances continuous improvements.
- Regular and constant interactions of staff with the senior management during the development of the IMS programme fosters effective communication and improves the awareness of the staff on their various tasks and responsibilities.
- Evidence-based decision making established on actual oversight into various processes and the flexibility it encouraged.

The challenges encountered in the course of the transition process involved the limitation of adequate knowledge on how to integrate processes to develop an IMS programme and the necessary requirements that shall be put in place, such as methodology, processes, tools and other resources, that facilitate the movement to a holistic and successful IMS programme. This led to the CERT Management decision to request for the IAEA support to facilitate the transition process.

Numerous lessons are being learned in the transition process which can so far be summarised as follows:

- Successful migration to an IMS driven organisational culture requires strong demonstrated support from the leadership team and its commitment to change.
- Because of the many tasks involved, the IMS implementation was divided in to three stages starting with the NIRR-1 facility in the first and second stages and systematically progresses to the entire organisation in the third stage.
- Eminent enhancement of financial and collaborative benefits is observed through research and development activities.

- The transition process has been instrumental in re-establishing and re-evaluating the basis for all aspects of the reactor and facility operations.
- The adoption of an integrated process-based approach to managing the operations of the research reactor has reduced the risk to the organization on loss of use due to unsafe operation or reactor inoperability.
- Improvement on discussions between the regulatory authority and the operating organisation in resolving raising issues.
- The process presents the pathway that the organisation may perhaps follow in the future for international best practice accreditation.
- There is the need to develop computer-based tools that should seamlessly fit into the organization which track process implementation and provide a framework for improvement. This could be a key to realizing efficiencies especially in situations of small staff numbers and high staff turnover.

IAEA support to NIRR-1 IMS transition programme

CERT acknowledges the IAEA supports in different aspects. Recently an expert mission to NIRR-1 facility was conducted on the IMS under IAEA Technical Cooperation (TC) project NIR1014 from 27 June to 01 July 2022. This was provided based on the facility request to overcome the challenges in the transition process for QA to IMS. The mission was conducted following the IAEA Implementation of a Management System for Operating Organization of Research Reactor, IAEA Safety Report Series No 75 [9], which is based on the IAEA safety standards. The activities of the mission included examination and assessment of technical documentation. A series of technical meetings in plenary sessions were conducted between the IAEA Experts, the NIRR-1 Management and operating personnel, including discussions about the main findings and recommendations of the mission, which were agreed upon by NAEC and CERT.

The IAEA Experts noted progress in many documents that NIRR-1 facility adapted to IMS. They also observed that most of the recommendations that were provided by the previous IAEA Integrated Safety Assessment of Research Reactor (INSARR) mission on IMS are being implemented. INSARR mission to NIRR-1 conducted in

2019 recommended implementation of IMS in NIRR-1 facility. The IAEA also supported a scientific visit to a facility that fully implemented the IMS programme for two CERT IMS team members including the IMS coordinator. This is in order to expand their knowledge and acquire the relevant experience to enhance capacity for the development of a comprehensive programme for NIRR-1.

CONCLUSION

The transition programme to IMS in NIRR-1 facility is in progress with the documentation of the IMS programme for the facility being developed for implementation in a graded approach and in compliance with regulatory requirements and following the IAEA safety standards. It is expected to integrate all processes in management of safety, security, health, environment, human and organizational factors, and economic objectives, covering all the stages of the facility lifetime. The establishment of the programme demonstrates the Management commitment to sustainable development essential for establishing an effective management system.

The development of the IMS in CERT was intended to be in three stages with full implementation in the NIRR-1 facility in the second stage which started by a systematic analysis of the existing situation and identification of gaps, as presented, then followed by comprehensive implementation in CERT at the third and final stage. The planning of the programme in stages essentially allows involvement of workers and stakeholders in a systematic manner to identify and review operations to define new objectives and possibilities for the pursuit of continuous improvements of processes and benefits such as accreditation for services, limited interruptions, reduced documentation, streamlined processes, and more consistent objectives.

The IAEA expert mission provided technical advice based on the IAEA safety standards to develop a plan to establish an IMS for the NIRR-1 facility. The mission reviewed and recommended an update of the existing QA and other technical documents related to the IMS to fill the gaps identified and additional new documents to achieve the objectives of the IMS. The experts in conjunction with the IMS team developed a project plan for establishing IMS for NIRR-1 which is currently being implemented.

ACKNOWLEDGEMENT

The continuous support of the IAEA to NIRR-1 facility and its Operating Organisation (CERT), is duly acknowledged.

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