INIS-mf--9635

CANADIAN NUCLEAR SOCIETY

COMMISSIONING SYMPOSIUM, MAY 3, 1983

"COMMISSIONING QUALITY ASSURANCE AT PICKERING NGS"

BY J.T. Wieckowski
Technical Superintendent - QA
Pickering NGS

1.0 INTRODUCTION

Nuclear Generation Division of Ontario Hydro has always had "quality operation" based on systematic and disciplined approach to commissioning, operations and problem definition and solving. Examples of elements of quality assurance which have been with us for a long time include:

- definition of station objectives
- provision of detailed operating and maintenance procedures
- identification, reporting, correction and follow-up of deficiencies
- change approval and control
- systematic approach to training and qualifications

and many others.

These elements, which have been introduced, documented and refined over the years have been a major contributor to the excellent performance of Candu reactors in the world.

In step with the rest of Ontario Hydro, and in recognition of its own long-term needs, the NGD have decided in 1978 to implement a formal QA program applicable to commissioning and operation of nuclear generating stations.

1.0 INTRODUCTION (continued)

Pickering NGS is the first station within Ontario Hydro which has had the Commissioning Quality Assurance (CQA) program applied to it. The program is based on and complies with the CSA-N286.4-79 (preliminary) standard - "Commissioning Quality Assurance".

The first step towards implementation of the CQA program was the formation of a Divisional QA Task Force which was charged with preparation of Nuclear Generation Division CQA manual. This manual was to provide interpretation of the CSA N-286.4 standard as it should be applied to Ontario Hydro's nuclear generating stations.

The formal CQA program - as defined in the NGD CQA Manual - was to integrate under one heading the long-existing elements of QA, and to add some new ones, the more important of which are:

- clear and unequivocal statement of divisional and departmental policy with respect to QA
- definition of section and unit responsibilities
- creation of consistent, comprehensive, coordinated, formal and up-to-date documentation system
- a clear requirement to verify all performance activities
- formalized operational and technical surveillance of station systems
- systematic and formalized follow-up of deficiencies requiring corrective (ie, long-term) action with respect to cause
- creation of record system to retain proof of work done

1.0 INTRODUCTION (continued)

- monitoring and audits of performance, verification and procedure compliance
- periodic reviews of effectiveness of the program.

The intention was for the CQA program to become an integral part of the commissioning process, an accepted part of doing our work. The overriding purpose was to ensure that instructions and procedures are followed and are effective, and thus contribute to achievement of station goals, especially in the areas of - public safety
- environmental protection
- employee safety.

At the time commissioning of Unit 5 had started, Pickering 'A', Units 1 to 4, had been operating for about 10 years and during that time, had been very successful. Obviously, most of the work done at Pickering NGS during commissioning and operation of Pickering NGS-A had been done right. We had to preserve, indeed nurture, this effectiveness, and therefore, did not want to make unnecessary changes to our way of doing things. Any changes - and there had to be a few, had to be carefully thought out to make sure that they would have desirable effects.

2.0 PLANNING FOR CQA

2.1 Scope of CQA Program

Our approach to determining the scope of the QA program was to analyze the commissioning process itself. We have

2.1 Scope of CQA Program (continued)

developed a flow diagram (see Figure 1) which describes the process and have decided that most steps shown on this diagram have to come under QA umbrella, as well as a number of peripheral/supportive activities not shown on our diagram.

2.2 Basic Principles

Several basic principles were decided very early:

1. Station policy with respect to QA shall be published in a station instruction, thus signifying the full support of NGD and station management for the CQA program.
2. The responsibility for quality is a normal and integral part of the workers' and supervisors' job. Management is responsible for specifying the performance standard to be met and also for provision of the necessary resources (training, procedures, tools) and of supervisory direction for the quality to be achieved.
3. The QA section is to act as a catalyst in implementation of the CQA program by:
   - defining detailed requirements
   - monitoring the status of the program
   - measuring quality
   - providing specialized training.

3.0 IMPLEMENTATION

"Pickering NGS Operations" is an organization operating a high technology plant. Over a thousand people are engaged in a

3.0 IMPLEMENTATION (continued)

multitude of diverse and complicated tasks. The regulatory requirements for quality performance and proof of it are stringent, compounded by the interest of the public and the media.

Some of the formal elements of the QA program were new to the majority of our staff and considerable amount of training was required. For these reasons it was not possible to introduce QA to Pickering in a "blanket fashion," ie, to all sections simultaneously. Instead, the QA program was introduced to various Pickering sections in order of priority where the need was the greatest.

The role of the QA Section during the introduction stage would be to:

- Explain and interpret QA requirements and conduct the necessary training.
- Ensure that a complete set of procedures are prepared.
- Provide a reference framework for sections to evaluate existing practices and procedures.
- Provide advice and direction in QA matters.

3.1 Sequence

The speed of implementation of CQA was constrained by the manpower resources of the QA Section and by the amount of time available in other sections. Due to its central role in the commissioning process, the Commissioning Section was the first to implement the CQA program. In addition, it was

3.1 Sequence (continued)

decided to apply our effort to the "common services," ie, sections/units in the plant organization which provide services and support the performance of other groups. These are:

- procurement and supply
- document and records management
- instrument calibrations
- maintenance documentation

A standard "section implementation sequence" was developed (see Figure 2) and applied by the various sections involved.

3.2 CQA Committee

To coordinate the efforts of the various sections a "CQA committee" was formed, consisting of representatives of the sections which were implementing the CQA program.

The objectives of this committee were:

1. To expedite implementation of CQA program.
2. To highlight problem areas in the implementation phase, and to recommend solutions.
3. To keep all sections at Pickering NGS informed of QA developments and progress, and to keep all members of the committee informed of the progress in other sections.

The committee met monthly and had 12 meetings in total.

3.3 Training

Training forms an essential part of the process of QA implementation. QA principles and basics, as well as new concepts must be explained to, understood and accepted by

3.3 Training (continued)

the staff. Nuclear Training Department developed a film and a text on QA basics. This training was supplemented at PNGS by presentations given by QA section staff. These presentations promoted three basic messages:

1. Definition of quality, specifically "what is quality".
2. "Right the first time" (our QA slogan) which says that its always cheaper in the long run to do the job right the first time.
3. "Everyone is responsible for the quality of their work."

These are almost self-evident, and were very well accepted.

3.4 Field Work

Field work, the routine, standard work done in the plant by shift crews, required the least effort to comply with QA requirements because the methods of doing work were familiar from Pickering NGS-A. Operating and maintenance procedures were prepared well in advance, the respective responsibilities were well defined. Very few adjustments were required.

3.5 Effort Expended

During 1981 a great deal of effort was expended in the implementation of the CQA program. 83 new documents were prepared as follows:

7 Station Instructions
21 Station Reference Plans
55 Standard Section Procedures

Most of these documents would have been required in any case, in order to direct and control the commissioning process.

3.5 Effort Expended (continued)

4 000 man-hours are estimated to have been spent in preparing these. Training in QA concepts and the new procedures was given to affected staff, approximately 3 000 man-hours being spent on that.

Some of the results were:

- Commissioning/Technical Section wrote procedures to deal with most activities identified on the "commissioning sequence diagram."
- Supply Unit prepared procedures dealing with ordering, receiving, storage, issue and traceability of material.
- The Maintenance Department set up instrument calibration program, including establishment of a "standards room" complete with standard instruments traceable to national standards.

3.6 Verification

Much effort was put into explaining the concept, methods and significance of the verification function. Performance activities have to be verified, but there are several ways in which verification can be carried out. At Ontario Hydro, verification is normally carried out by the performer's supervisor and includes sufficient verification of the job itself and verification of the accompanying documentation. We believe that verification by the supervisor is the best way to ensure satisfactory quality of performance. Accountability for quality is then clearly placed with the person doing the job and his supervisor. It is very

3.6 Verification (continued)

important that first line supervisors understand clearly what is expected of them during verification and also what their signature on a document means.

3.7 Commissioning Review Meetings

Commissioning review meetings are a new element in the commissioning process. They were introduced in order to afford the Commissioning Manager, and various other interested parties, an opportunity to review commissioning methods, results and documentation for all station systems.

The meetings are conducted by the Commissioning Superintendent responsible for the system and by his subordinates.

They are attended by the Commissioning Manager, QA Superintendent a representative of the jurisdictional authority and representatives of Design organization.

Several related systems may be reviewed at a single meeting, but all systems are eventually reviewed.

The objectives of these meetings are:

1. To review in depth the completeness of the commissioning process applied to the system, including review of results obtained.
2. To identify all outstanding actions and changes, and specifically those that must be completed before system can be declared "in service."

3.7 Commissioning Review Meetings (continued)

3. To review the status of commissioning and operating documentation.

4. To provide added assurance and confidence that commissioning had been executed satisfactorily.

The meeting starts with a presentation by the engineers who directed commissioning of the system. Meeting participants ask questions and discuss commissioning results. Formal review of status of documentation follows. For Unit 5, 30 meetings were held during which 127 systems were reviewed.

These meetings have made a great contribution to the quality of commissioning for the following reasons:

- They required the Commissioning Superintendents and their staff to formally review results of their activities before presenting them at the meeting. This sometimes resulted in realization that some activities have been inadvertently omitted or not pursued sufficiently far.
- They required review and compiling of commissioning records into a well organized file.
- They enforced a formal review of status of system documentation (eg, operating manual, flowsheet, jumpers, etc) and required a commitment for its completion.
- They provided a forum for review by designers and senior station staff of commissioning results.

4.0 MONITORING AND EVALUATION OF PROGRAM EFFECTIVENESS

Three mechanisms exist by which the quality of performance and the adequacy of the QA program are measured and confirmed. These are:

- Monitoring by the QA Section.
- Audits by a head office department (RMEP).
- Quality Assurance Review Committee meetings (QARC).

4.1 *Monitoring*

Monitoring is conducted by QA Section technicians in accordance with a predetermined plan and specific directions with respect to individual monitoring checks. Monitoring provides direct and prompt feedback on the extent to which the performance activities conform to procedures.

The characteristics of monitoring are:

1. Frequent and routine checks of key indicators of quality.
2. The "checking" covers a number of activities but not to the same depth as an audit would.
3. Many aspects of a job are looked at, rather than just documentation.
4. Problem areas and departures from the desired standard are detected early because of frequency of checks.
5. Findings are carefully recorded, but presented less formally than would be the case with an audit.
6. The QA Section, normally participates in the development and assessment of the proposed solution.

4.1 Monitoring (continued)

Monitoring subjects, called "quality indicators" are selected because they are deemed to offer a significant indication of quality because:

- they are important components of the commissioning process
- compliance with standards is easily measured and quantified.

So far, we have selected 46 quality indicators, typical examples of which are:

- flowsheets (correct and complete)
- change control (proper approvals and documentation)
- commissioning procedures (correct and pertinent)
- operating memos (approved and reviewed by shift)
- jumpers (under control)
- maintenance procedures (complete and up-to-date)
- wiring verification (completeness of, and method)
- spare parts (correct storage, identification and issue)
- records retrieval (available on demand)
- document control (up-to-date, correct routing)

and many others.

For 1983, our plan calls for 60 monitoring checks. In addition, we have also allowed for another 15 unplanned monitoring checks to be carried out in response to identified concerns or requests from the station management or the QA superintendent. Findings are presented in monitoring reports, which are distributed to management staff responsible for corrective action. These are followed by deficiency reports,

4.1 Monitoring (continued)

if appropriate, and by meetings with QA staff to discuss the proposed corrective actions. Summaries of monitoring findings (many of these positive) and of corrective actions are reviewed monthly by the Station Manager with the QA Superintendent.

4.2 QA Audits by Head Office Department

The commissioning process is audited from time to time by the Radioactivity Management and Environmental Protection Department (RMEP). The purpose of the audit is to provide independent assessment of the commissioning process, field work and documentation on behalf of the Director of NGD. Five commissioning audits have been held so far, resulting in 80 deficiency reports, of which 63 have already been resolved. Auditors probe deeply into their selected areas, and submit formal reports to the Director. Station staff have the opportunity to review the findings, prepare a response and agree to corrective actions before the audit report is formally submitted.

4.3 QA Review Committee (QARC)

The QARC meets at least once a year, and its objective is to review the adequacy and direction of the QA program. QARC membership consists of senior station and head office staff, all from NGD. The reviews examine various inputs and concentrate on the results achieved by the QA program. Where the committee deems it appropriate, it recommends changes to the QA program in emphasis or direction. Typical inputs

4.3 QA Review Committee (QARC) (continued)

examined by the QARC are audit and monitoring results, commissioning assurance meeting results, and quality trends as evidenced by deficiencies.

5.0 CORRECTIVE ACTIONS

Identification and correction of deficiencies whose long term correction requires investigation and elimination of the cause of the defect, as well as the defect itself is a very important part of our QA program. Elimination of the cause ensures that the defect is permanently dealt with and will not re-appear.

The existing, well tried and developed "deficiency report" (DR) system is used to identify, follow-up and record action on such deficiencies. Computerized records are kept and summaries are available on request. A total of 159 of such deficiencies have been identified so far, of which 35 were considered "major".

6.0 CONCLUSIONS

When reviewing the results of the CQA program, with respect to Pickering 5, one must seek answers to some very basic questions:

- What were our expectations with respect to the CQA program, were they reasonable and clearly defined?
- Has the program satisfied our expectations?
- Has our end product been any better for the effort expended towards CQA?

6.0 CONCLUSIONS (continued)

- Did we avoid any troubles? How would we know?
- What are our recommendations, what will we do different for Units 6 to 8,

or what would we recommend for other stations, about to be commissioned.

6.1 Expectations

Our expectations with respect to the QA program were that:

1. Organizational structure and responsibilities will be clearly defined, thereby avoiding confusion and duplication of work.
2. We will have a coherent and complete documentation system, including good procedures.
3. We will acquire a good set of records of commissioning methods and of results.
4. We will have an effective means of measurement of quality.
5. And last, but most important, that all of these measures will in the end result in achievement of station objectives in an effective and cost efficient manner.

We did not expect dramatic improvements over our previous commissioning efforts, which took place 12 years ago. We did a very good job then, even though we fell short on many of the QA requirements which are mandatory today. Nevertheless our end product then was excellent, and its hard to improve on excellence.

6.1 Expectations (continued)

The essential difference between then and now is the different regulatory climate, brought about by pressure of public opinion in Canada and USA. What was acceptable then, simply would not be acceptable today.

6.2 Results

To the extent that we have been able to measure - and our measurements are imperfect - the CQA program has satisfied Ontario Hydro's and AECB's expectations. It would have been naive to expect clear indications of superiority of commissioning effort on Unit 5 as compared to Unit 1, except in the areas of formalized organization, procedures, materials control, instrument calibrations, and records management. These are tangible and definite improvements. Some of them would have to be put in place as a matter of good management to cope with demands from the regulatory authority for performance standards and records. CQA program provided a convenient reference frame to coordinate and accommodate these. In terms of overall results, ie, quality and reliability of safety related equipment and systems, elimination of potential problems, long-term operational performance, the influence of CQA, and OQA, is hard to discern yet and will take a long time to become clearly demonstrated.

6.3 Direction for the Future

Operations QA program has gradually been implemented on Unit 5, with full implementation coinciding with declaration of "in service". We shall continue with the CQA program to commission Units 6, 7 and 8. As the program matures it will be gradually refined and more emphasis will be put on activities which bear directly on performance, such as:

- competence and training
- procedure adherence
- verification.

Measurement of quality will be improved as new "quality indicators" are identified. Procedures will be streamlined to accomplish their intent and to promote productivity. Trends will also be looked at to detect and prevent incipient problems. Improvement targets will be annually set, so that gradual and continuous improvement takes place. QA must do more than merely satisfy jurisdictional requirements, it must also become a positive force towards improved productivity

I would estimate that for a plant the size of Pickering NGS, at least 5 years of hard work is required before commissioning and operations QA programs are in a mature state. Our experience to date convinces us that achievement of this goal will be to our long-term benefit.

COMMISSIONING ACTIVITY SEQUENCE DIAGRAM (SIMPLIFIED)

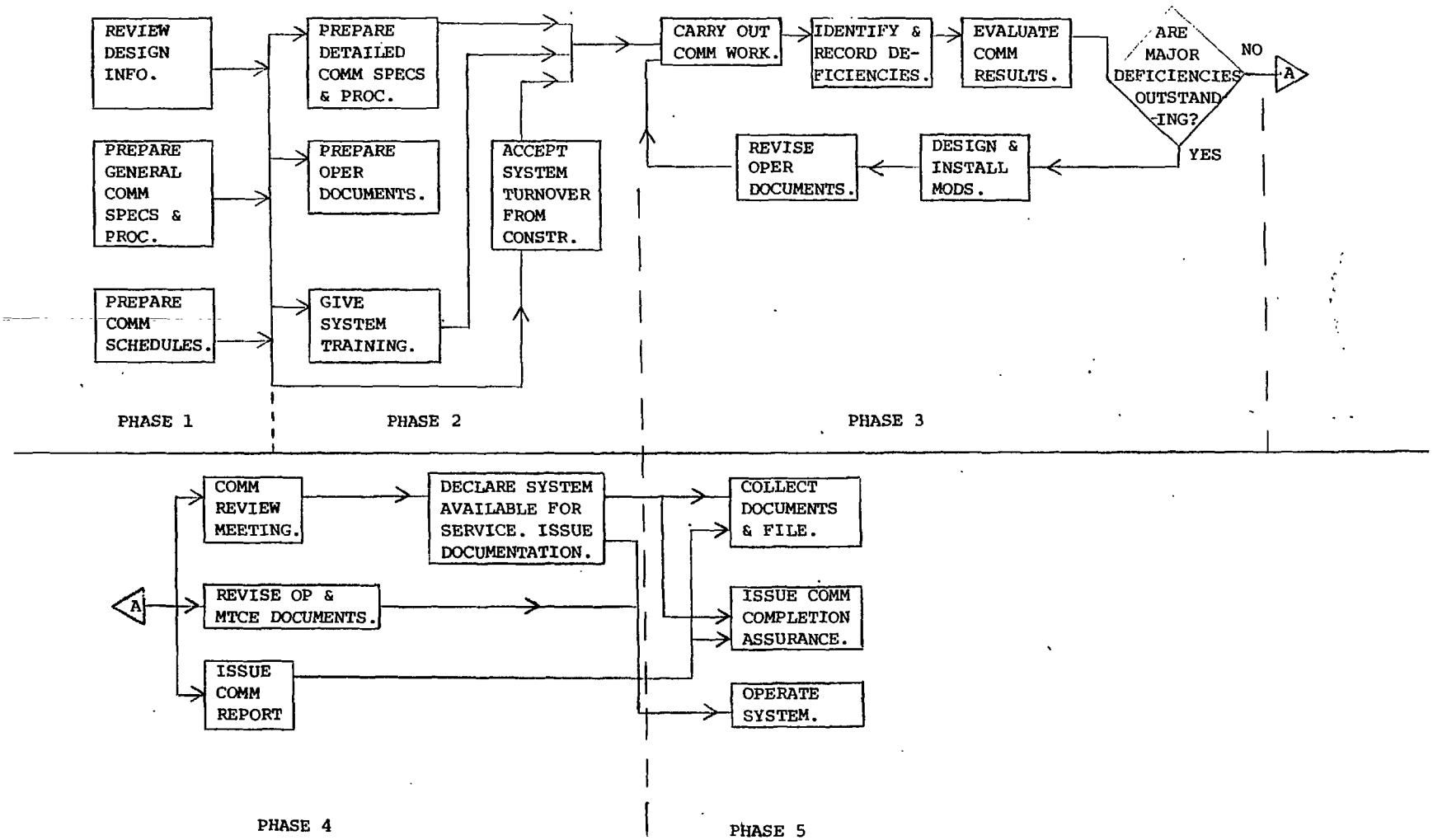

FIGURE 1

MODEL OF QUALITY ASSURANCE PROGRAM

IMPLEMENTATION SEQUENCE

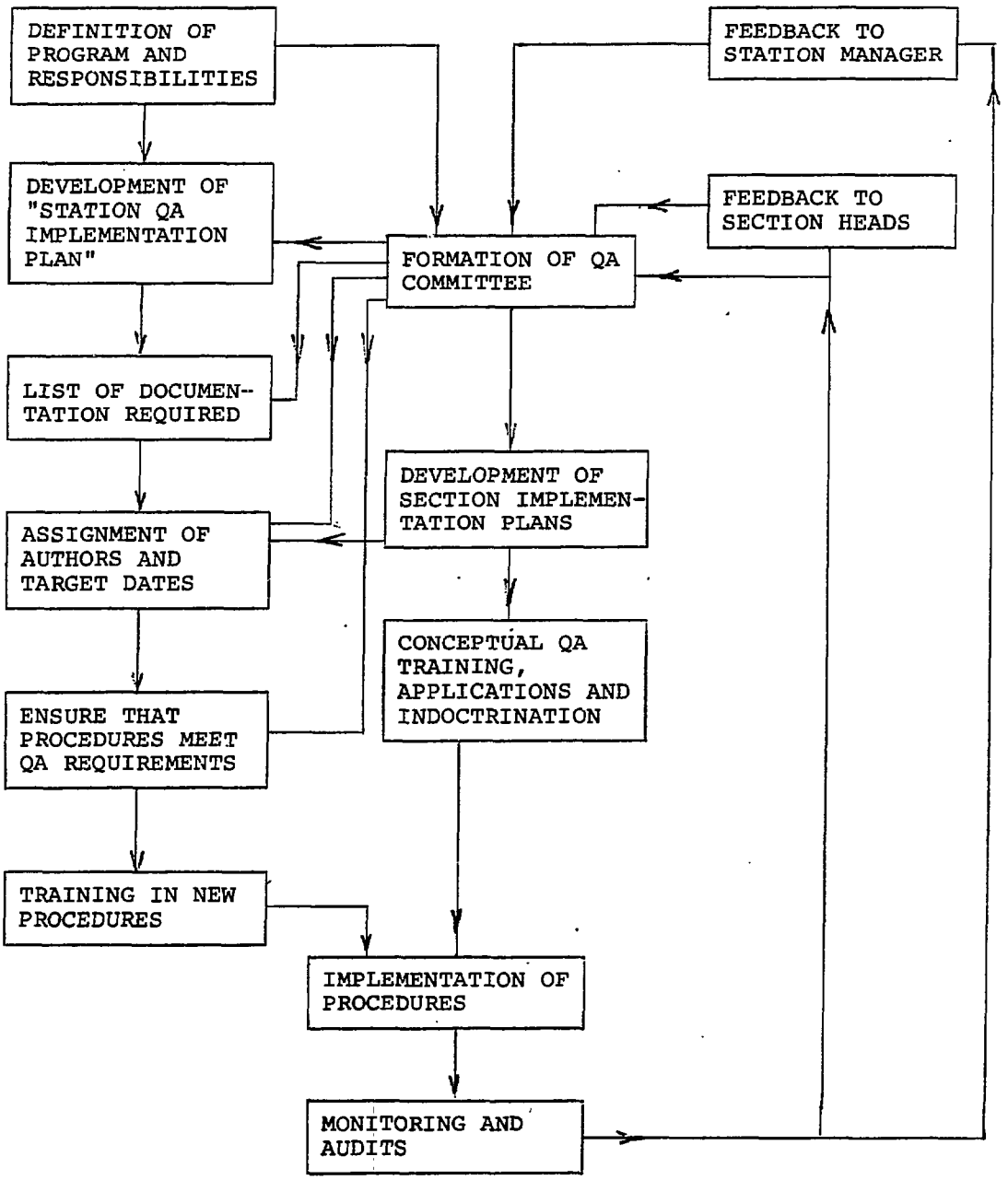

FIGURE 2