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Managing suspect and counterfeit items in the nuclear industry

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FOREWORD

Some manufacturers and suppliers use inferior materials and processes to make substandard supplies whose properties can vary significantly from established standards and specifications. Other suppliers distribute items that they know do not meet the purchase requirements or provide documentation that misrepresent actual conformance to established specifications and standards. These substandard supplies, or ***s***uspect/***c***ounterfeit ***i***tems (S/CIs), pose potential threats to the safety of workers, the public and the environment and may also have a detrimental effect on security and operations at nuclear facilities.

Nuclear facilities often procure and use commercial-grade items and the quality assurance policies/procedures and procurement methods are not always properly applied to avoid the entry of S/CIs into those facilities. This publication offers practical guidance on how to apply existing quality assurance programmes to effectively prevent the procurement and use of S/CIs. In particular, it provides a practical method of applying the requirements and guidance contained in the IAEA Safety Series 50-C/SG-Q: Code and Safety Guides on Quality Assurance for Safety in Nuclear Power Plants and other Nuclear Installations (1996), to the S/CIs issue.

The preparation of this publication took place between October 1999 and May 2000. Two meetings were held with experts of various Member States who contributed with their experience in nuclear facility quality policy and regulation development, quality assurance programme implementation, design, procurement and enforcement. The preliminary draft was distributed to interested organizations in several Member States, including manufacturers, suppliers, regulators and certification/accreditation bodies, for comments and inputs that were considered and included where appropriate in the final version.

The IAEA received valuable financial support from the Department of Energy (DOE), United States of America, for the development of this publication.

The Secretariat wishes to acknowledge the efforts and assistance provided by the contributors and participants at the preparatory and review meetings, listed at the end of this publication. The IAEA is especially grateful to G. Danielson, USA, the main writer of the original manuscript, and to N. Redman, United Kingdom, who reviewed the final manuscript. The IAEA staff member responsible for this work was N. Pieroni of the Division of Nuclear Power.

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1. INTRODUCTION

1.1. Background

A suspect item is one in which there is an indication by visual inspection, testing, or other information that it may not conform to established industry-accepted specifications or national/international standards. A counterfeit item is a copy or substitute without legal right or authority to do so or one whose material, performance, or characteristics are knowingly misrepresented by the vendor, supplier, distributor, or manufacturer. In this publication the terms ***s***uspect and ***c***ounterfeit ***i***tems (S/CIs) are combined and will be treated as such throughout this publication.

International attention to the issue is warranted because the underlying conditions and causes contributing to the ongoing S/CIs problem are common to all nuclear facility operators as well as other industries. S/CIs may pose immediate and potential threats to the safety of workers, costs, plant performance, the public and the environment. S/CIs originate from a variety of locations around the world and encompass a variety of materials.

S/CIs may be already installed in and may be inadvertently procured for the nuclear installation. All S/CIs need to be identified as early as practicable and their individual impact on safety, costs and work schedules evaluated in order to determine an appropriate course of action. This includes communicating and sharing information internally and with the whole nuclear industry

In many countries the nuclear facilities are constantly challenged to reduce operating costs due to the competition induced by deregulation of private facilities or decreased funding for government owned facilities. This changing operating environment can lead to a reduction in the staff responsible for vendor qualification and receipt inspections. The remaining staff are doing more and are likely to have less opportunity for the training needed to recognize S/CIs. In this environment it is important to raise awareness of the hazards presented by S/CIs. The hazards can be reduced by effective implementation of the IAEA Quality Assurance Code and Safety Guides [1] coupled with the S/CIs specific information in this publication.

Engineering and procurement personnel are also challenged by changes to the supply chain. Increasingly items from the original manufacturer are no longer available, or the manufacturer is not willing to support the rigorous testing and documentation needed for some items. Engineering and procurement personnel often rely on commercial grade items being available from suppliers who obtain the items from a variety of sources. Unfortunately, these conditions are well suited to the vendor who is willing to intentionally supply S/CIs in order to increase their profit margin. Some vendors take advantage of poorly defined procurement documents/specs, weak or absent vendor qualification processes, weak or absent receipt inspection programmes, and a lack of vendor information sharing among nuclear facility operators.

The identification and disposition of S/CIs can be conducted using the existing quality assurance Programme. New processes are not required. S/CIs are potential non-conforming items and therefore their treatment can be integrated into the normal non-conformance process.

Non-conformity that results from one or more of the following conditions are not normally considered to be S/CIs:

- Defects resulting from design errors or common production quality control failures.
- Damage during shipping, handling, or storage.
- Improper installation.
- Deterioration during service.
- Degradation during removal.
- Failure resulting from ageing or misapplication.

Some non-conforming conditions may be recorded in the receipt documents and be endorsed by the supplier, or may be recorded in receipt inspection documents. All non-conforming items including S/CIs should be addressed by the site procedures for non-conformance control and corrective actions as defined by the IAEA Safety Guide 50-SG-Q2 [2].

Experience shows that S/CIs include a wide range of items such as threaded fasteners, piping components and electrical components. S/CIs are more likely to appear when:

- The items are manufactured and procured outside of the quality assurance programme (commercial grade items).
- The items are expensive to manufacture.
- The items are expensive to test.
- The procurement requirements are poorly defined.
- The method for verifying that the procurement requirements are met is inadequate.
- The urgent replacement of a failed item is required.

1.2. Objective

This publication is intended to assist organizations in developing and implementing quality assurance policies, programmes, procedures and practices to eliminate the hazards created by S/CIs that are present in nuclear facilities and to prevent any further introduction of SC/Is.

1.3. Scope and users

The methods and processes described in this publication apply to both items important to safety and items not important to safety installed or procured for all nuclear facilities in all their lifecycle stages.

The intended users of this publication include the managers and staff of nuclear facilities, and their supplier organizations, which are involved in the following functions:

- Engineering
- Procurement
- Inspection
- Training
- Quality Assurance and Assessment
- Maintenance
- Operations
- Construction.

The methods and processes described in this publication are based on practical experience and the current requirements of the referenced IAEA documents. Additional or alternative methods may be acceptable if they adequately ensure both worker and public safety as well as product quality.

1.4. Structure

This publication is arranged into six sections. Sections 2 to 4 reflect the structure of the IAEA Code 50-C-Q [1] (Management, Performance and Assessment):

- Section 2 outlines the activities that “management” should address in relation to the subject.
- Section 3 describes the activities that should be addressed by those ‘performing’ work to effectively manage and disposition S/CIs.
- Section 4 outlines the activities that could be included in an ‘assessment’ programme to address the subject matter.
- Section 5 provides a listing of symptoms of common S/CIs.
- Section 6 provides some examples of specific S/CIs and the lessons learned from them.
- Annex 1 outlines some relevant experience from a Member State.
- Annex 2 provides an example of a procedure for the management of non-conforming items.
- Annex 3 provides an example of a procedure describing the procurement of commercial grade items.

2. MANAGEMENT

2.1. Management responsibility

Management is responsible for providing the resources necessary to assure personnel have the knowledge and capability to prevent S/CIs from entering the facility, and to identify and disposition S/CIs that already exist in the facility.

The IAEA Quality Assurance Code [1] states that management is responsible for developing the quality assurance programme (QAP). A QAP that incorporates the guidance of this publication will:

- Ensure that items intended for application in safety systems comply with the design, applicable specifications/standards, and procurement documents.
- Identify and disposition S/CIs that create potential hazards in systems and applications.
- Report discoveries of and share information about S/CIs within the facility and with external organizations.
- Train managers, supervisors, and workers on the prevention, detection, and disposition of S/CIs.
- Maintain current, accurate information on S/CIs and associated suppliers using all available sources within the industry.
- Analyse S/CI information for trends.
- Obtain remedies from suppliers of S/CIs.

The guidance contained in this publication may be used to assess the adequacy of existing arrangements in managing S/CIs. Current QAPs should be compared with this publication to ensure that they address the specific guidance relevant to the S/CI issues. For example, an existing QAP prepared using IAEA Safety Guide 50-SG-Q2 [2] should already address non-conformance control and corrective actions but may need some additional guidance for S/CIs identified in the nuclear facility.

Management should ensure that arrangements are put in place for S/CIs that include tracking and reporting, training, communication and information sharing as well as non-conformance reporting and disposition.

2.2. Tracking and reporting

2.2.1. Tracking

A database that records the location of all stored and installed S/CIs in the facility, the application they are used in and the disposition status of all installed S/CIs will assist tracking, reporting, and future maintenance activities and help prevent unintentional re-use of the item.

The tracking of S/CIs should use methods and processes similar to those used for the tracking on non-conformances.

2.2.2. Regulatory reporting

When an S/CI is identified that is important to safety, consideration should be given to reporting the issue to the regulator at an early stage. It may also be beneficial to involve the regulator in plans to assess the extent of the problem and the evaluation and disposition activities. The involvement of the regulator should be carried out in accordance with the regulatory reporting arrangements of the Member State.

2.3. Training

Personnel should be trained, within their respective areas of responsibility, to identify, prevent, and eliminate the introduction of S/CIs into the facility. Training should address the contents of this publication and include the use of practical examples from the organization and industry.

Specific training should be considered for:

- The detection of installed S/CIs.
- Identifying S/CIs during receipt and inspection.
- Using S/CI information within the procurement process.

2.4. Communication and information sharing

Significant benefits can be realized by sharing all instances of S/CIs with outside organizations in the nuclear industry. Use of shared S/CI information saves both personnel and financial resources. For instance, learning of S/CIs from a shared information source can assist the facility operator to identify any possible instances and their locations at the nuclear facility. This example would save inspection time and the time to rectify any performance problems should the S/CI fail in-service. Engineering evaluation time and effort can also be reduced through shared testing or analytical results. There are currently a number of organizations that maintain systems with information on operational events, receipt inspection, and other problems that could be useful for S/CI identification.

Some examples of organizations that communicate and share relevant information are:

IRS — The IAEA International Event Reporting System.
WANO/INPO — Website and NUPER database where event reports can be scanned (open to Members only).
CANDU Owners' Group (COG) Information Exchange System.

Industry organizations are encouraged to maintain lists of S/CIs identified in their field of activity, to disseminate them to interested facilities and to initiate measures in order to prevent or limit the manufacturing, import or sale of S/CIs.

2.5. Non-conformance identification and disposition

S/CIs that are identified during receipt inspection, warehouse/storage inspections, maintenance, modification, or facility walk-down should be handled in accordance with existing local non-conformance procedures. An engineering evaluation should establish the disposition of installed S/CIs (reject, repair, rework, accept with conditions and accept without modification).

Figure 1 illustrates how a process from identification through to disposition of discovered S/CIs integrates into the normal non-conformance process. This process may vary according to local procedures and regulatory requirements.

3. PERFORMANCE

3.1. General

It is generally recognized that those facilities most effective in detecting S/CIs have common characteristics:

- An engineering department that serves in a leadership role responsible for tracking and evaluation of S/CIs.
- Engineering staff involvement in procurement and product acceptance.
- Effective source inspection, receipt inspection, and testing programmes.
- Thorough, engineering-based programs for review, testing, and dedication of commercial-grade products for suitability in safety systems.

3.2. Engineering

Engineering involvement is generally warranted to support procurement, product inspection and acceptance testing, and the evaluation that leads to dispositioning, particularly when items have been counterfeited in the past.

The extent of engineering involvement should be determined by a graded approach based on the nature and intended application of the purchased product. Engineering involvement in procurement and product acceptance may be minimal when existing acceptable items are to be replaced during maintenance or modification with like items or if the safety risk is low.

Engineering involvement increases with the probability of procuring known S/CIs and may include the following activities to ensure the items will comply with design intent and specifications:

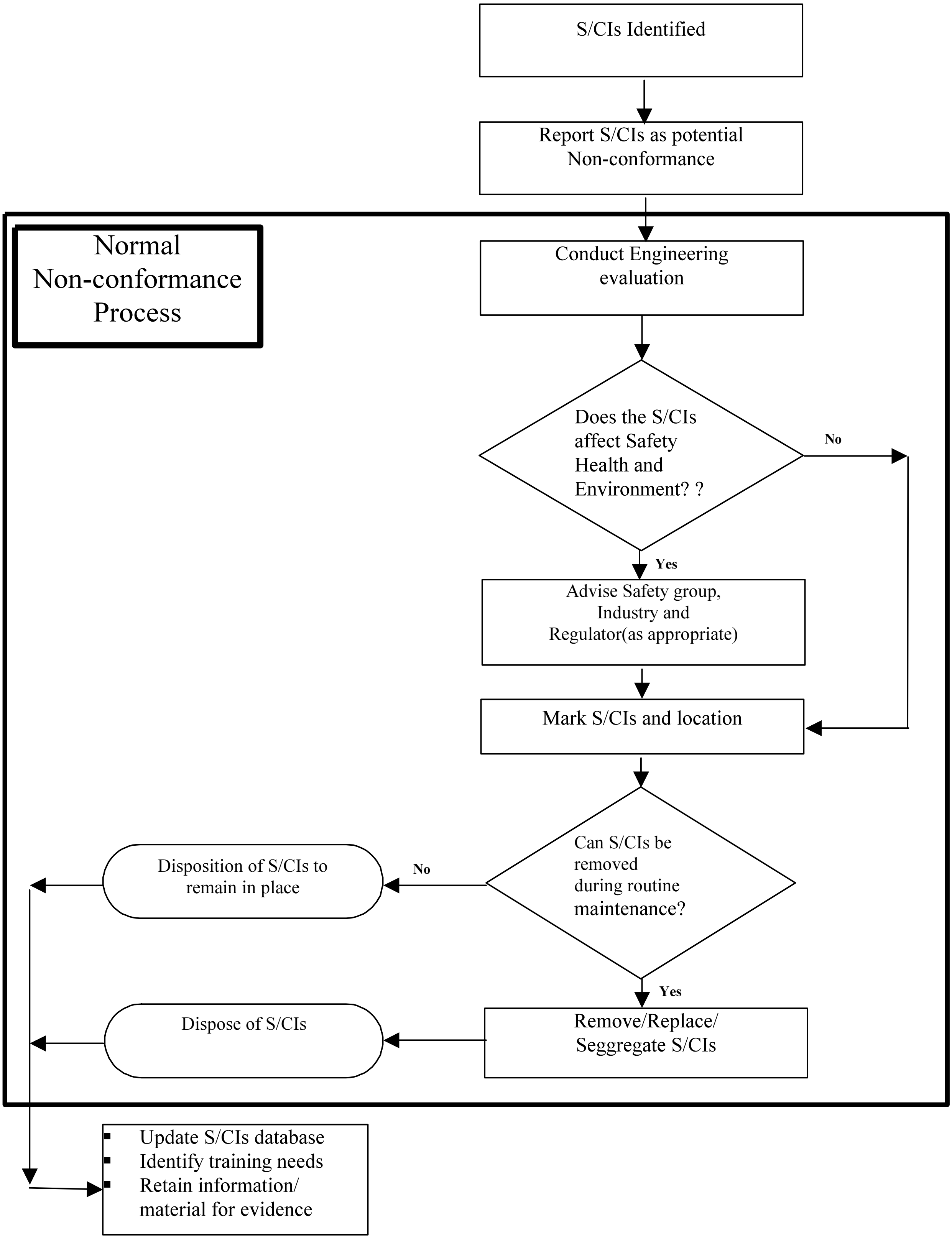

FIG. 1. Integration of S/CIs into the non-conformance process.

3.2.1. Engineering involvement in procurement activities

- Developing technical specifications for the procurement of facility items. The IAEA Code 50-C-Q [1] and Safety Guide 50-SG-Q6 [3] contain information for ensuring that appropriate requirements are specified in procurement documents.

- Determining critical characteristics of purchased items that should be specified in the procurement documents and selecting those characteristics to be verified during inspection and testing for acceptance.

- Reviewing technical changes to and deviations from procurement documents.

3.2.2. Engineering involvement in product inspection and acceptance testing

- Determining specific inspection and testing requirements and methods applicable to the acceptance of products. The extent of inspection and testing should be based on the possibility of the item's being counterfeited, the sample size and value of the shipment, and the item's function. In the absence of a performance-based audit of the supplier, verification testing is appropriate, particularly when purchasing from suppliers who are neither the original manufacturers nor authorized distributors and for whom there is no past performance information. Testing may be performed during receiving inspection or post-installation inspection.
- Reviewing and accepting the manufacturer's Inspection and Testing Plan for manufactured items, establishing the "witness "and "hold" points and requiring the purchaser's presence, during the fabrication process.
- Participating, on behalf of the procurement organization, in the surveillance of fabrication activities and/or in the performance of tests at the manufacturer's facility.
- Participating in audits, surveillance and source inspections to verify the technical performance capability of suppliers of items important to safety.
- Evaluating acceptance test results.
- Participating in the receiving inspection of items as well as reviewing certificates and reports supplied with the item.

3.2.3. Engineering input to information management

- Maintaining a database of S/CIs and suppliers of such items, based on the lists/bulletins issued by regulatory and inspection authorities, on information from outside organizations, and on facility experience of stored and installed S/CIs. Making the data/information available to all relevant departments.
- Participating in the review of information supplied through experience feedback channels on SC/Is.
- Identifying new requirements for the installed items (which could arise from new norms and standards, from possible inconsistencies between different design documents, etc.) and extending accordingly the list of the S/CIs — installed or stored as spares.

3.2.4. Engineering input into evaluation and disposition

- Conducting an engineering evaluation to determine whether a system can be operated in its present configuration without modification or replacement of a S/CI, or whether the system needs to be locked out, tagged out, and removed from service immediately. As a general rule, S/CIs should not be installed in the facility. Engineering evaluation should be performed to determine if an S/CI could be removed from storage for installation or use (normal or conditional).

- Specifying in the engineering evaluation results any conditional use of the system and any compensatory actions that will ensure the least possible threat to public and worker safety. In addition to evaluating the safety impact of S/CIs, engineering should consider the impact on performance (e.g., reliability, output, production) and the cost of replacement. Annex 2 provides and example from a Member State on its arrangements for the conditional release of S/CIs.
- Developing criteria for disposition of S/CIs by removal, replacement, or acceptance after an engineering evaluation, based on the deficient characteristic of the particular item. Annex 3 provides an example from a Member State on its arrangements for the disposition of S/CIs.
- Evaluating S/CIs installed in the plant as soon as possible, starting with items important to safety, in order to assess how the malfunction of the S/CIs would affect nuclear safety, industrial safety, health and the environment. The evaluation will establish the disposition of the installed S/CIs.
- Developing methods to indicate the acceptability of S/CIs determined by engineering evaluation to be acceptable for use in their current application (e.g., painting bolt heads a distinctive color).
- Giving input, based on the S/CIs data-base, to planning and procurement departments for:
  - the schedule of maintenance activities and the outage schedule, in order to include the replacement of the installed S/CIs with new, conforming items;
  - The purchase orders for the procurement of new items, necessary to replace the installed S/CIs allowed to be used in operation only for a limited period of time.
- Controlling the status of S/CIs within the facility.

3.3. Procurement

The underlying principles in procurement are:

- suppliers have demonstrated they are capable of delivering acceptable items;
- procured items meet established requirements and perform as specified,
- procurement requirements and verification activities are carried out to an extent and rigour commensurate with a graded approach based on the items' importance to safe and reliable operation and,
- suppliers continue to provide acceptable items after initial selection.

The procurement process begins with the specification of what is needed and the establishment of procurement requirements; it ends with receipt of an acceptable item. The procurement process should be an effective first barrier to S/CIs entering the facility. Information on procurement activities is contained in IAEA Code 50-C-Q [1], Safety Guide 50-SG-Q6 [2] and TECDOC-919 [4].

The procurement of S/CIs should be avoided. Contracts with vendors known to supply S/CIs or the procurement of items that are known to have been counterfeited in the past should be conducted with increased rigour and attention to quality requirements.

3.3.1. Procurement requirements and documents

For the procurement process to become an effective barrier to S/CIs, all existing and available sources of S/CI information should be used as input to process. The regulatory and inspection authorities should be encouraged to issue periodic lists/bulletins about S/CIs in their field of activity. Each nuclear facility should have its own list of S/CIs and of suppliers of such items, and maintain it up to date.

Procurement documents, including purchase orders and contracts, should require that items be new — not reconditioned, used, or repaired — unless otherwise specified by the contracting organization. Procurement documents should contain conditions that prohibit delivery of S/CIs or misrepresentation of the item. The supplier needs to be made aware of their accountability for providing the correct items and the consequences for supplying S/CIs.

The procurement documents should also include provisions for retaining part of the fee until the items are received and confirmed to meet requirements and inform the supplier of the potential for monetary penalty and criminal liability for supplying S/CIs. Procurement documents should mandate the supplier to repair or to replace items found to be S/CIs including those that failed in time, after a period of operation, due to hidden defects.

Procurement documents should also prohibit subcontractors from bringing S/CIs on site and hold subcontractors accountable for replacing S/CIs at their expense. An example of a quality clause for procuring fasteners which requires the supplier to confirm that, an item does not contain S/CIs would be:

> *"The supplier assures that suspect or counterfeit fasteners are not provided as part of the end item for delivery under this purchase order. Items containing suspect/counterfeit parts will not be accepted. Suspect or counterfeit fasteners are those identified by the combined headmark list/chart attached."*

Credit/purchase cards are increasingly used to order and pay for items important to safety. This method of payment should only be used when quality clauses and other procurement documents needed to prevent the receipt of S/CIs have been invoked in a current contract.

Any item known to have been counterfeited in the past (see Section 6) should be procured from qualified or dedicated suppliers, particularly items important to safety.

Items procured through surplus or other uncontrollable channels for use in important to safety applications that require traceability should be supported by documentation of their conformance or, in the absence of such documentation, verified for acceptability by inspection or acceptance testing. Accepting items based solely on supplier-generated documentation or part-number verification increases the risk of S/CIs entering the facility, unless the supplier provides traceability back to the manufacturer or the item has been previously verified through performance-based evaluations.

3.3.2. Supplier selection

Safety Guide 50-SG-Q6 [3] describes effective supplier selection methods. It is also recommended that when an item is procured from a vendor or distributor, the manufacturer should be identified and, depending on the item's importance to safety, references should be collected about the manufacturer in order to assess his credibility. Additional emphasis for the prevention of S/CIs includes the use of shared information resources to address a supplier's history of providing S/CIs.

3.4. Inspection and testing for acceptance

Item verification and certification documentation (e.g., certified material test reports) alone may not be sufficient to verify the quality of purchased items and can increase the likelihood of accepting S/CIs. Engineering attributes and quality assurance criteria specified in the procurement documents should be verified at receipt. Inspection and testing procedures should be updated to include new information regarding S/CIs found in industry. The knowledge and ability of the engineering and technical staff should be employed to support the identification of S/CIs by receipt inspection staff. Safety Guide 50-SG-Q4 [5] contains guidance on the inspection and testing process.

Items should be inspected for symptoms common to S/CIs (see Section 5) by personnel who are trained to recognize S/CIs. Representative samples of items should be inspected before they are accepted to verify conformance to specified requirements. Large lots of received items may be sampled using the criteria of a recognized statistical sampling standard. Where S/CIs are discovered during inspection or sampling (including those items lacking appropriate documentation), the lot should be identified and reported as early as possible in the inspection process. These items are treated as non-conforming and dispositioned in accordance with the site non-conformance process.

On-site stores and inventories (such as maintenance tool bins) should be also inspected to ensure they have been purged of S/CIs.

Procured equipment that is found at any time to contain S/CIs should be withheld from installation or use pending engineering evaluation. If the evaluation determines that the S/CIs has the potential to adversely affect the safe performance of the equipment or system, it should not be used, and the S/CIs should be replaced at the supplier's expense and the manufacturer notified. If it is determined (through engineering evaluation, verification, or disposition process) that the item conforms to specified requirements and will not create a potential safety hazard, the item may be installed or used.

Temporary use of an S/CI or equipment containing S/CIs may be necessary. The engineering evaluation should provide compensatory safety measures. Annex 2 provides and example from a Member State of a procedure for the conditional release of S/CIs.

When the design specifies the use of commercial-grade items in safety systems, one or more of the following methods could be used by the purchaser to provide reasonable confidence that the items meet the acceptance criteria:

- Special tests and inspections on receipt and post-installation.
- Survey of the commercial-grade supplier.
- Source verification.
- Past performance record of the supplier or item.

Annex 3 provides an example from a Member State of a process for the procurement and utilization of commercial grade items.

3.5. Disposition of installed S/CIs

Procedures should address any S/CIs installed in the plant in items important to safety and in items not important to safety. This is necessary to ensure S/CIs do not migrate from one system to another as well as to reduce all other hazards for health and the environment.

The procedures and practices should include provisions for inspecting, identifying, reporting, evaluating, testing, removing, replacing, and the final disposition of S/CIs using a graded approach. The procedures should utilize the existing process for non-conforming items. An engineering evaluation should establish the disposition of installed S/CIs (reject, repair, rework, accept with conditions and accept without modification).

S/CIs permitted to either remain in place, or be removed later during planned or routine maintenance, should be clearly identified by marking or other appropriate means.

3.5.1. Items important to safety

Current lists of nuclear facility systems provide a basis for establishing priorities, for conducting inspections and for identifying and dispositioning discovered S/CIs.

An engineering evaluation should be conducted to determine where and how the S/CIs is used; it's potential for adverse effects on safety, and its proposed disposition. Potential hazards to workers that may occur before the disposition of S/CIs is complete should be recognized. The existing safety or hazards analysis processes should be used in the evaluation.

If S/CIs create a potential safety hazard, an engineering evaluation should determine whether:

- The item or plant system containing the S/CIs should be removed from service immediately, locked out, and tagged out until the S/CIs have been replaced with acceptable items; or
- The item or plant system can be used (with or without limitations on operation) until the item can be replaced.

If the engineering evaluation determines that the S/CIs do not affect safety, they may remain in place. S/CIs left in place should be properly identified and marked by painting or by other suitable means to prevent reuse in an application where it may not be suitable. Sampling inspection and special inspection techniques, (e.g., portable testing equipment) may be used to locate and evaluate S/CIs installed in important to safety applications.

3.5.2. Items not important to safety

S/CIs discovered in items or plant systems not important to safety that could create health or environmental hazards should be treated in accordance with Section 3.5.1. S/CIs identified in a not important to safety application should prompt an inspection for similar items or equipment used in important to safety applications.

S/CIs in not important to safety applications that do not create health or environmental hazards should be treated as follows:

- Paint or otherwise identify the S/CIs.

- Remove, replace, and dispose of the S/CIs during routine maintenance, repair the S/CIs or disposition the S/CIs to remain in place.

3.5.3. Disposal of S/CIs

S/CIs should be removed when an engineering evaluation has determined that the S/CIs could affect safety. The normal non-conformance disposition process should be applied for the evaluation and removal of the item.

Removed S/CIs should be permanently and irrevocably altered or marked so they cannot be used in a safety application. Examples of alteration include melting, shredding, or destroying the threads on fasteners; crushing circuit breaker casings; or embedding fasteners in concrete or other media, rendering them useless.

Disposition may include the need to retain S/CIs for further analysis, material properties testing, developing preventive actions, training for S/CIs identification, or to pursue any financial/legal remedy with the supplier. S/CIs should also be disposed of in accordance with Member State environmental requirements.

4. ASSESSMENT

IAEA assessment requirements of the Quality Assurance Code 50 C-Q [1] are applicable to S/CIs management and performance issues. IAEA Safety Guide 50-SG-Q5 [6] contains guidance on performing Management Self-Assessment and Independent Assessment.

4.1. Management self-assessment

Managers should assess the effectiveness of their processes and actions in identifying and resolving S/CIs, as part of the normal management assessment activity.

4.2. Independent assessment

Independent assessment should evaluate the adequacy and implementation effectiveness of the organization's processes for the prevention and elimination of S/CIs. These independent assessments should include an evaluation of contractors who perform work for the facility that could introduce S/CIs.

Individual assessments would include subjects such as:

- Resource allocation (especially for supplier qualification and receipt inspection).
- Use of industry S/CIs information systems.
- Procurement process integrity.
- Regulatory interface.
- Employee awareness.
- Engineering involvement and participation.
- Identification of installed S/CIs.
- S/CIs related training.
- Disposition of S/CIs.

5. SYMPTOMS OF SUSPECT/COUNTERFEIT ITEMS

5.1. Potential S/CIs

S/CIs can encompass a broad range of items, such as:

- Threaded fasteners.
- Electrical/electronic components: circuit breakers, computer components, semiconductors, printed circuit boards, current and potential transformers, fuses, resistors, switchgear, overload and protective relays, motor control centres, heaters, motor generator sets, DC power supplies, AC inverters, transmitters, cables.
- Piping components: fittings, flanges, valves and valve replacement products, couplings, plugs, spacers, nozzles, pipe supports.
- Diesel generator speed governors and pumps.
- Spare/replacement kits from suppliers other than original equipment manufacturers.
- Pre-formed metal structures, elastomers, O-rings, seals, weld filler material and chemical supplies.

5.2. S/CIs locations

S/CIs have been discovered throughout industry in a variety of locations, such as:

- Cranes, elevators, and fork lifts and critical load paths of lifting equipment.
- Aircraft: engines and attachments, wings, tails, or landing gear.
- Vehicles: engines, brakes, or steering mechanisms.
- Facilities: valves, compressors, and vessels used to contain radioactive fluids, high-temperature or high-pressure steam or fluids, cable tray rooms with high fire risk, or other hazardous material or systems supporting safe operation or shutdown of a facility or process.

5.3. Symptoms of common S/CIs

The following examples of some common S/CIs and their symptoms have been compiled from actual experience:

5.3.1. General

- Nameplates, labels, or tags have been altered, photocopied, or painted over; are not secured well; are unusual in location and method of attaching; show incomplete data; or are missing. Pre-printed labels normally show typed entries.
- Item has worn marks or scratches on external surfaces.
- Obvious attempts at repair or re-conditioning have been made: excess painting or wire brushing, evidence of hand painting (touch-up), painted stainless steel.
- Handmade parts are evident; gaskets are rough cut; shims and thin metal part edges show evidence of cutting or dressing by hand tools, for example filing, hacksaw marking, tin snips, or nippers
- Hand tool marks exist on fasteners or other assembly parts; upset metal exists on screw or bolt head or dissimilar parts are evident; seven or eight bolts are of the same material and one is of different material.
- Assembled items fit poorly.

- Metallic items are pitted or corroded.
- Casting markings have been ground off and item has been re-stamped with other markings.
- Configuration is inconsistent with other items from the same supplier or varies from that indicated in supplier literature or drawings.
- Component or item is unusually boxed or packed.
- Supplier is not a factory-authorized distributor.
- Dimensions of the item are inconsistent with the specification requested on the purchase order and those provided by the supplier at the time of shipment.
- Item or component matches the description of one that is on a Member State list of S/CIs.

5.3.2. Circuit breakers

- Case is cracked or appears used.
- Laboratory product testing authority label/mark, or the original manufacturer's label/mark shows signs of being altered or copied (e.g., black and white, poor legibility).
- Circuit breaker rating shows signs of being altered (e.g., rating painted on instead of being impressed into the case) or contradictory amperage ratings appear on different parts of the same refurbished breaker.
- Rivets or other connectors used to hold the case together are not proper type or size or rivets have been removed; the case may be held together with wood screws, metal screws, or nuts and bolts.
- Certificates are copied or show evidence of falsification (where possible, original certificates should be obtained from the distributor).
- Style of the breaker is no longer manufactured or is old.
- Breaker comes in cheap, generic-type packaging (e.g., bulk-packaged in plastic bags, brown paper bags, or cardboard boxes with hand-written labels) instead of the manufacturer's original boxes.
- Data on carton or label have been altered or are inconsistent.
- Manufacturer's seal across the two halves of the case of the breaker is broken or missing.
- Manufacturer's date code is not stamped on the breaker.
- Wire lugs show evidence of tampering.
- Surface of the circuit breaker may be nicked or scratched yet has a high gloss.
- Rating stamp is in the wrong place.
- Third-party markings are on item.
- Terminal lugs are on both ends.
- Terminal hardware is wrong size or type or is mismatched.
- Cover screw seals are missing or rough or are poorly resealed.

5.3.3. Electrical devices

- Connections show evidence of previous attachment (upset metal or marring).
- Electrical leads are of different lengths or are not as long as stated in vendor product catalogue.
- Connections show arcing or discoloration.
- Fasteners are loose, missing, or show upset metal.
- Moulded case circuit breakers are consistent with manufacturer-provided checklists for detecting substandard/fraudulent breakers.

- Products requiring testing by an independent authority are missing labels or labels appear to be photocopied.
- Manufacturer's labels are discoloured or faded, indicating they may have been photocopied.
- Item shows evidence of wear or prior use.
- Item has scratches or nicks in factory paint or coating.

5.3.4. Fasteners

- Headmarkings are marred, missing, or appear to have been altered.
- Threads show evidence of dressing or wear (threads should be uniform in color and finish).
- Headmarkings are inconsistent within a heat lot.
- Headmarkings appear to be impression-stamped after production.

5.3.5. Rotating machinery and valve internal parts

- Item shows marring, tool impressions, wear marks, traces of Prussian blue or lapping compound or other evidence of previous attempts at fit-up or assembly.
- Item shows evidence of heat discoloration.
- Item shows evidence of erosion, corrosion, wiredrawing, or “dimples” (inverted cone-shaped impressions) on valve discs, seats, or pump impellers.

5.3.6. Valves

5.3.6.1. Paint

- Valve appears freshly painted and valve stem has paint on it.
- Item has worn marks on any painted surface.
- Valve stem is protected, but protection has paint on it.
- Paints do not match standard original equipment manufacturer's colour.

5.3.6.2. Tags

- Tags are attached in a different method or location than normal.
- Tags appear old, worn, or newer than the valve.
- Tags have paint on them.
- Tags have irregular stamping.
- Screw heads affixing tags to part are marred from use.

5.3.6.3. Hand wheels

- Hand wheels appear to be older than the valve.
- Hand wheels appear sandblasted or newer than the valve.
- Different types of hand wheels are on valves of same manufacturer.

5.3.6.4. Bolts and nuts

- Bolts and nuts appear used (e.g., wrench marks on flats).
- Item has improper bolt and nut material (e.g., bronze nut on stainless stem).

5.3.6.5. Body

- Item shows evidence of ground-off casting marks; other markings are stamped in the area (original equipment manufacturer's markings are nearly always raised, not stamped).
- Item shows signs of weld repairs.
- Incorrect dimensions are obvious.
- Item shows evidence of fresh sandblasted appearance, including eyebolts, grease fittings, stem, etc.
- Item shows evidence of previous bolt head scoring on backside of flanges (or this area has been ground to remove such marks).
- The finish on a new stainless steel valve is between dull and shiny — a shiny finish usually indicates bead blasting; a dull finish usually indicates sand blasting.

5.3.6.6. Manufacturer's logo

- Manufacturer's logo may be missing.
- Logo plate appears to be newer than the valve.
- Logo plate shows signs of discoloration from previous use.

5.3.6.7. Price

- Price is significantly lower than that of the competition.

5.3.6.8. Other

- Foreign material is inside the valve (e.g., metal shavings).
- Valve stem packing shows all the adjustments have been run out.
- A gate in a gate valve is off-centre when checked through the open end of the valve.
- Obvious differences exist between valves in the same shipment.

6. EXAMPLES OF SUSPECT AND COUNTERFEIT ITEMS AND THE LESSONS LEARNED

This section provides an illustration of some examples of known S/CIs for specific types of components and the lessons learned following their identification.

6.1. Fasteners

- The use of S/CIs high strength bolts was evaluated as being acceptable in applications where normally lower strength bolts were used.

  Lessons learned
  — The S/CIs high strength bolts were not identified or marked as such, leading to the potential that they could be re-used in applications where genuine high-strength bolts were required.

- Stainless steel bolts were hand-stamped to indicate they met a different standard.

  Lessons learned
  — The method of identifying bolts allowed for raised or depressed head markings which would enable someone to add stamping after production. Reliance on head stamping to identify bolts could lead to potential problems without manufacturer certification.

6.2. Refurbished circuit breakers

- Refurbished moulded-case electric circuit breakers continue to be widely counterfeited and misrepresented as new. Moulded-case circuit breakers should not be taken apart and serviced or refurbished except by the original manufacturer or qualified supplier.

  Lessons learned
  - Refurbished moulded-case circuit breakers should not be accepted without the original manufacturers or qualified suppliers' certification.

6.3. Metal struts and fittings

- Vendors have been found who mix unmarked substitute struts and fittings with properly identified products and ship the parts in the original manufacturer's box. This practice misrepresents the product as being from the original manufacturer.

  Lesson learned
  - Facilities should use metal strut materials purchased for structural applications from reputable manufacturers that will have the manufacturer's name, logo, or part number on the part for ease of identification. Markings also identify the load capacity that the part is designed and rated to withstand.

6.4. Steels

Procured during construction:

- Steels were ordered to a specific standard but were supplied to another standard, for financial gain.
- Suspicion aroused when the material test reports were checked.
- Solution: Additional Charpy impact tests were performed, absorbed energy met the original acceptance criteria, and the steels manufactured to the other standard were accepted.

  Lesson learned
  - Receipt inspection should be performed thoroughly to detect suspect items.
  - Supplier should be monitored and controlled more strictly.

6.5. Pump shafts

Used for spare parts of fire protection pumps, procured during operation:

- Suspicion identified when the run-out check of the pump shafts was performed at the receiving inspection.
- Solution: engineering decision made to discard the shafts and purchase new ones.

  Lessons learned
  - Receipt inspection should be performed thoroughly to detect suspect items.
  - Run-out of pump shaft should be checked before installation because misalignment or run-out of pump shaft can be induced by improper handling, shipping, transportation, or manufacturing.

6.6. Throttle valves and piping

Used in the rear side of component cooling water heat exchangers, procured during construction and installed:

- Suspicion appeared when throttle valves and rubber-lined piping was damaged by cavitation as a result of sudden throttling during the commissioning test.
- Solution: to avoid cavitation and optimize the efficiency of the heat exchanger the design was changed by installing a cone type orifice in the rear side of the throttle valve and changing the valve size; damaged valves and pipes were replaced with larger ones.

Lessons learned

— Anti-cavitation design should be considered in the throttle line.
— Experience and design changes were incorporated into next plant design.

6.7. Rubber gasket

Used on the fuel handling pit gate, procured during construction and installed:

- Suspicion appeared when a leakage from the gate was detected; the leakage came through the damaged gasket as a result of inappropriate installation of a clamp to fix the gasket and the unexpected ageing of the gasket
- Solution: damaged parts of gasket repaired and leak-tested.

Lessons learned

— Installation should adhere to the technical specification.
— Spare parts inventory updated to consider replacing the suspect items more frequently.
— Preventive maintenance methods established and implemented as follows: daily check for leakage of the gasket considering ageing effect; visual inspection of the gasket during the annual outage; detail check every five years in accordance with the manufacturer's instruction.

6.8. Swing type check valves

Procured during construction and installed next to the orifice of the discharge side of motor operated auxiliary feed water pumps:

- During preventive maintenance, it was discovered that the disc bolt was ruptured and the detached bolt, nut, washer, and fixing pin had disappeared into the feed water system.
- Solution: Eddy Current Testing and engineering evaluation were performed to assess the effect of loose parts on the steam generator; disc bolt was replaced with a thicker one; the weak parts of the valve were reinforced.

Lesson learned

— Similar valves supplied by same supplier should be checked periodically during the annual outage or, if necessary, normal operation.

6.9. Seal injection filter

Used on front side of the reactor coolant pump, procured during construction and installed:

- Suspicion aroused when the seal injection flow "low" signal alarm was initiated as a result of blocking of the seal injection flow by a build up of filtering material in the seal housing of the reactor coolant pump
- Solution: Impurities in the seal housing and system were removed by flushing; the location of the differential pressure gauge was moved to a low radiation area by design change to allow frequent check of differential pressure.

Lessons learned

- The filtering material should be replaced periodically taking into account any unforeseen ageing effect caused by use in a differential pressure environment, regardless of manufacturer's instruction.
- Differential pressure of the filter should be checked frequently.

6.10. Reactor vessel guide studs

Used when assembling and disassembling the reactor vessel, procured for construction in accordance with thread type design and installed:

- Suspicion aroused when the threads of the guide stud and stud hole were damaged during the commissioning tests.
- Solution: design change from thread type to sleeve type was made, damaged thread of guide stud was discarded and stud hole thread was bored.

Lesson learned

- Experience and design change was incorporated into next plant design

6.11. Reactor coolant pump seal housing bolts

Procured during construction and installed:

- During the annual outage, suspicion aroused when a leakage between the seal housing and the bolt ring of a reactor coolant pump was detected. The disassembly of the seal housing revealed all the bolts were corroded or rusted by boric acid leaked into the seal housing.
- Solution: corroded bolts replaced with new ones; non-destructive examination (NDE) and engineering evaluation on the rusted bolts performed and a leakage check was performed after bolting.

Lessons learned

- Maintenance procedure for reactor coolant pump seal housing was revised to prevent the inflow of boric acid into the seal housing.
- Periodic check performed to identify any leakage.

6.12. Chemical waste drain tank

Used in liquid radwaste system, procured during construction:

- Suspicion aroused when NDE was not carried out on the nozzle welds as a result of misinterpretation of the NDE requirements in the procurement specification.
- Solution: liquid penetrant examination performed in accordance with specification and tank accepted.

Lesson learned

— Receipt inspection should be performed thoroughly to ensure all tests have been carried out in accordance with the procurement specification.

6.13. Flange bolts of tank

Procured during construction and installed:

- Suspicion discovered when quality surveillance identified that flange bolts were not fully engaged with nuts.
- Solution: all the bolts were replaced with longer ones to allow full engagement.

Lesson learned

— Receipt inspection should be performed thoroughly to check that bolts are fully engaged in nuts on assemblies.

6.14. Electrical and instrumentation and control cables — fire retardant

Procured during construction:

- Supplied from the warehouse of a nuclear power plant (NPP) from a utility in another country.
- Suspicion aroused when the test certificates were checked (cable specifications and tests were in accordance with the country's national, obsolete standards).
- Supply accepted due to financial benefits and impact on work schedules.
- Solution: tests were repeated to current standards, cables were installed in the unit, engineering assessment established compensatory measures (fire detection system, sprinklers for extinguishing fires, protection of structural steel with intumescent paints, fire barriers on cable trays).

Lessons learned

— Some documents sent with items might also be suspect; the documents confirming design features of the item should be signed by a neutral evaluator.

— The use of suspect items is permissible, if appropriate compensatory measures are taken.

6.15. Transformers

Procured during construction:

- Stored for a long time in conditions (variable temperatures and humidities) that were not strictly controlled; possible insulation/paper degradation occurred.
- Installed in the unit.
- Suspicion aroused when several transformers failed during commissioning (short circuits, fires).
- Solution: new transformers were ordered (insulation: moulded resin) and stored on the site in suitable conditions, in order to enable the immediate replacement of failed transformers in the future.

Lessons learned

- An evaluation/inspection of the item status should be carried out prior to installation, in order to assess the effect of the storage conditions on the item.
- The spare parts and components inventory should take into account the necessity to replace any installed suspect items when they fail.

6.16. Electronic cards in logic loops

Procured during construction and installed:

- Suspicion aroused when spurious trip signals were generated in some pins on the card, when the card failed (the situation generated a reactor trip during the commissioning tests). The manufacturer confirmed the failure as being generic in nature following a request by the NPP to carry out an investigation.
- Solution: modification implemented in the loops which used such pins and which had an impact on other similar logic; the balance of the cards was kept unchanged.

Lessons learned

- The approach to the disposition of the suspect items should be related to the importance of the item for safety, or for the plant's availability.
- Any suspicions should be identified at an early stage, during the commissioning tests, if possible (schedule special tests for S/CIs).
- Ask for information and clarification from the supplier together with an investigation on any faults identified in order to simplify the engineering evaluation.

6.17. Liquid relief valves

Used in degasser-condenser, operating in tandem with the pressurizer, procured for construction, in accordance with the standard design, and installed.

- Suspicion aroused through feedback that suggested that other NPPs of the same design replaced these valves with new ones, with better dampening features.
- Suspicion confirmed during a transient, when the unit was shutdown, and the valves operated, but did not close properly (they "chattered"), generating heavy water losses.
- Solution: repair of the valves (for short term); order of new valves similar to those utilized by other NPP's with installation to take place during the annual outage.

Lessons learned

- The "database" of S/CIs should be permanently monitored, in order to take into account the operating experience of other NPPs.
- The replacement of such items should be considered as an important part of the annual outage work.
- The replacement of the suspect items could be implemented with the co-operation of other NPPs interested in such work.

6.18. Identification and markings

The following are examples of S/CIs that were discovered as a result of improper markings:

- Metal flanges stamped as forgings when other markings on the face of the flange indicated that the parts were cold rolled.
- Metal flanges as part of fabricated assemblies without any required markings on the flanges, such as the manufacturer, material type, specification or dimension.
- Metal eyebolts either with no manufacturer's markings or with markings indicating that the parts were made in a country other than specified. Eyebolt dimensions had not met specifications and material types were indeterminate.
- Metal piping and pipefittings requested from national manufacturers received from foreign manufacturers.
- Lifting devices purchased with procurement credit cards had been visibly altered, as evidenced by over-stamping or striking through original information and adding new markings.

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Annex 1
EXPERIENCE ON SUSPECT/COUNTERFEIT ITEMS

In the United States of America, the S/CIs issue was addressed as early as July 1988 by a US Nuclear Regulatory Commission (NRC) Notice 88-96. The NRC discoveries of suspect electrical equipment at commercial nuclear facilities led another federal agency, the Department of Energy (DOE), to conduct site-wide S/CIs inspections. Other significant efforts in the USA to control S/CIs include the following:

- The Fastener Quality Act of 1990 requires that fasteners conform to the specifications to which they are represented as being manufactured. It also provides for the accreditation of laboratories engaged in fastener testing and requires inspection, testing, and certification of fasteners used in critical applications.

- The DOE Quality Alert Bulletin 92-4, issued in August 1992, summarized previously disseminated US Customs Office information on S/CIs.

- The DOE study, *Independent Oversight Analysis of Suspect/Counterfeit Parts within the Department of Energy*, published in November 1995, noted a high degree of inconsistency and incompleteness among some DOE sites in addressing S/CIs issues. A follow-up study conducted May 1996, found improved procurement procedures that were effective in reducing the introduction of S/CIs. However, this study also noted that further improvements were needed in the co-ordination, integration, and dissemination of S/CIs information.

The most common S/CIs found at DOE facilities have been threaded fasteners that are fraudulently marked as high-strength material and refurbished electrical circuit breakers sold and distributed under false certifications. Purchasers have also been misled by falsified documentation into accepting S/CIs that do not conform to specified requirements.

Annex 2
EXAMPLE PROCEDURE ON PROVISIONS FOR THE MANAGEMENT OF NON-CONFORMING ITEMS

At Cernavoda NPP, Romania, the management of the issue of non-conforming items, which includes S/CIs, is performed in accordance with the provisions of the documents of the QA programme. Apart from the QA manual, there are mainly two types of such documents:

- Reference Documents, reflecting the basic principles;
- Station Instructions, containing detailed description of the activity.

The main provisions of these documents, related to the non-conforming items, is contained in the following Station Instructions:

- **Station Instruction: "Goods and Services Receiving Inspection"**

The Receiving Inspection Commission for an item purchased by the plant includes:

- Representatives of the Procurement and Material Control departments,
- Manufacturers (where appropriate),
- The System Engineer, responsible for the system where the item will be installed in the plant, who initiated the procurement order for the item,
- A QA engineer.

The items are inspected to confirm they meet the technical requirements included in the Purchase Request, Purchase Order or Technical Specification.

The item will be stored in accordance with the requirements given in the manufacturer documentation, or, if such requirements are not included in the documentation, the Commission will establish the appropriate conditions.

Any deficiencies revealed at the receiving inspection are recorded in a non-conformance form.

The non-conforming items are tagged with a specific yellow label.

The non-conforming items are stored in a "quarantine area" of the warehouse.

A Non-Conformity Report (NCR) is raised, when the use of a non-conforming item might be necessary, with the aim to establish in what conditions the item could be used. The NCR disposition could be:

- Item accepted as it is;
- Item to be repaired/ upgraded in a certain manner;
- Item to be rejected.

The NCR disposition is completed with the removal of the item from the "quarantine area" and the label changed to a green one (if the item was accepted as it is, or after the upgrading).

The temporary use of a non-conforming item could be accepted through a "conditional release" which has to be carried out in accordance with the following Station Instruction.

- **Station Instruction: "Conditional Release"**

The conditional release will cease to be valid when its time limitation expires and will be removed when the NCR disposition is established and approved.

The purpose of the Station Instruction is to provide the necessary controls when:

- Non-conforming items have to be used for a limited period of time in order to support plant operation in safe and economic conditions.
- Other materials than those indicated in the design have to be used/installed for a limited period of time in order to support plant operation in safe and economic conditions.

The non-conforming items or the items different from those indicated by design do not remain on conditional release longer than necessary.

Such items will be used if the non-conformance is deemed not to interfere with the correct functioning of the equipment / system/ station.

A conditional release is not initiated and approved if the item may become damaged or a potential safety hazard could result.

The Conditional Release Request (CRR) is based on a technical assessment of the temporary modification against the initial design as a result of using the non-conforming item. If safety is involved, the Station Manager approves the CRR and be acceptable to the regulatory body.

(Outside of normal working hours or in an emergency situation, the Shift Supervisor will give the authorization for the conditional release implementation. On the next working day all necessary approvals will be obtained in accordance with the procedure).

The Technical Manager when endorsing the CRR ensures that:

- The requirements of Operating Policies & Principles (the main Safety Document for operation) are met when an item is used with a CRR.
- A time limitation for the clearance and for the review of the conditional release is established.

The System Engineer confirms that the items/materials that are different from those indicated in the original design meet the design requirements for the use of the item for a limited period of time.

The status of the conditional released items is maintained in a database, to be used by System Engineers, QA Department and Material Control Department (stores and quarantine areas).

After implementation a conditional release is reviewed on the established date. The review will decide if the item should be:

- Removed, or
- Review date revised and extended, or
- Accepted as permanent, if the engineering evaluation (conducted as per NCR procedure) confirmed this method of disposition.

If the conditionally released item is removed or accepted as permanent, the CRR will be closed, with all subsequent updating of documents and the database.

No more than one extension of the date of a Conditional Release Report is recommended. Removed non-conforming items are returned to the Material Control (quarantine area) or to the shop for repair, if a repair was chosen as the method of disposition for the non-conformity.

Annex 3
EXAMPLE OF A COMMERCIAL GRADE ITEM PROCUREMENT PROCEDURE

UTILIZATION OF COMMERCIAL GRADE ITEMS IN
KOREA ELECTRIC POWER CORPORATION (KEPCO)

The KEPCO QA program incorporates quality requirements for the utilization of commercial grade items (CGIs), which meet the definition of commercial grade items contained in 10 CFR 21 regulation and which is dedicated to ensure compliance with 10 CFR 50 Appendix B regulation.

- The KEPCO QA program manual states that:
  - — Commercial grade items may be used as substitute for safety related items where:
    - (1) The cognizant design organization verifies that the alternative commercial grade item will perform the intended function and will meet design requirements applicable to both the replaced items and its application, and the commercial grade item is identified in an approved design output documents.
    - (2) It is determined that suppliers who meet the applicable quality requirements for spare or replacement parts are not available, or the use of commercial grade items is beneficial. In this case, applicable technical evaluation and selection of acceptance methods are performed in accordance with approved procedures, and supplier evaluation shall be performed, if necessary.
  - — Where commercial grade items are used in lieu of safety-related items, special inspection and/or testing requirements that are more restrictive than the supplier's published product description are required. The responsible design organization verifies that the item meets the design requirements, and specifies the verification results in the final design output documents.
  - — Receiving inspection of commercial grade items verifies that:
    - ▪ Damage was not sustained during shipment
    - ▪ Received items are correct ones as ordered
    - ▪ The item has satisfied the specified acceptance criteria, and
    - ▪ Specified documentation, as applicable to the item, was received and is acceptable.

- QA guidelines for the utilization of CGIs are developed with the following contents:
  - — Purpose: to determine that the method of dedication, utilization of commercial grade items in safety- related applications, is adequate and complies with applicable codes, standards, and regulations.
  - — Applicable codes, standards and guidelines:
    - ▪ ASME NQA-1
    - ▪ EPRI Guidelines
      - – NP-5652 "Guideline for the Utilisation of Commercial Grade Items in Nuclear Safety Related Applications (NCIG-07)" (June 1988)

    - NP-6406 "Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants (NCIG-11)" (Dec. 1989)

  - US NRC Generic Letters
    - 89-02 "Actions to Improve the Detection of Counterfeit and Fraudulently Marked Products" (Mar. 1989)
    - 91-05 "Licensee Commercial-Grade Procurement and Dedication Programs" (Apr. 1991)

- The utilization of commercial grade items intended for safety-related applications involves the following two processes:

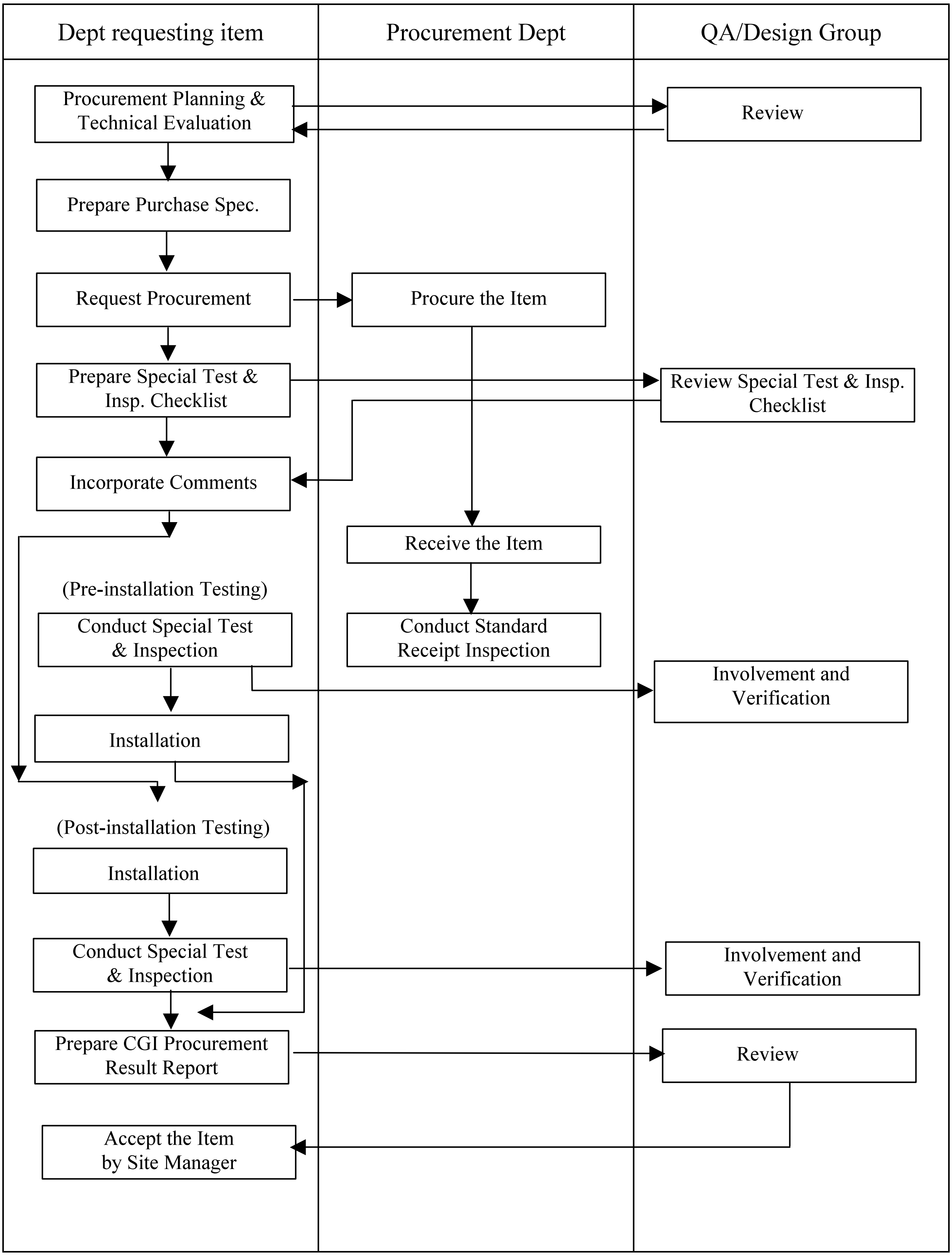
  (1) Technical evaluation, which identifies which acceptance method or combination of acceptance methods are to be used.

  (2) The acceptance methods are one or more of the following:

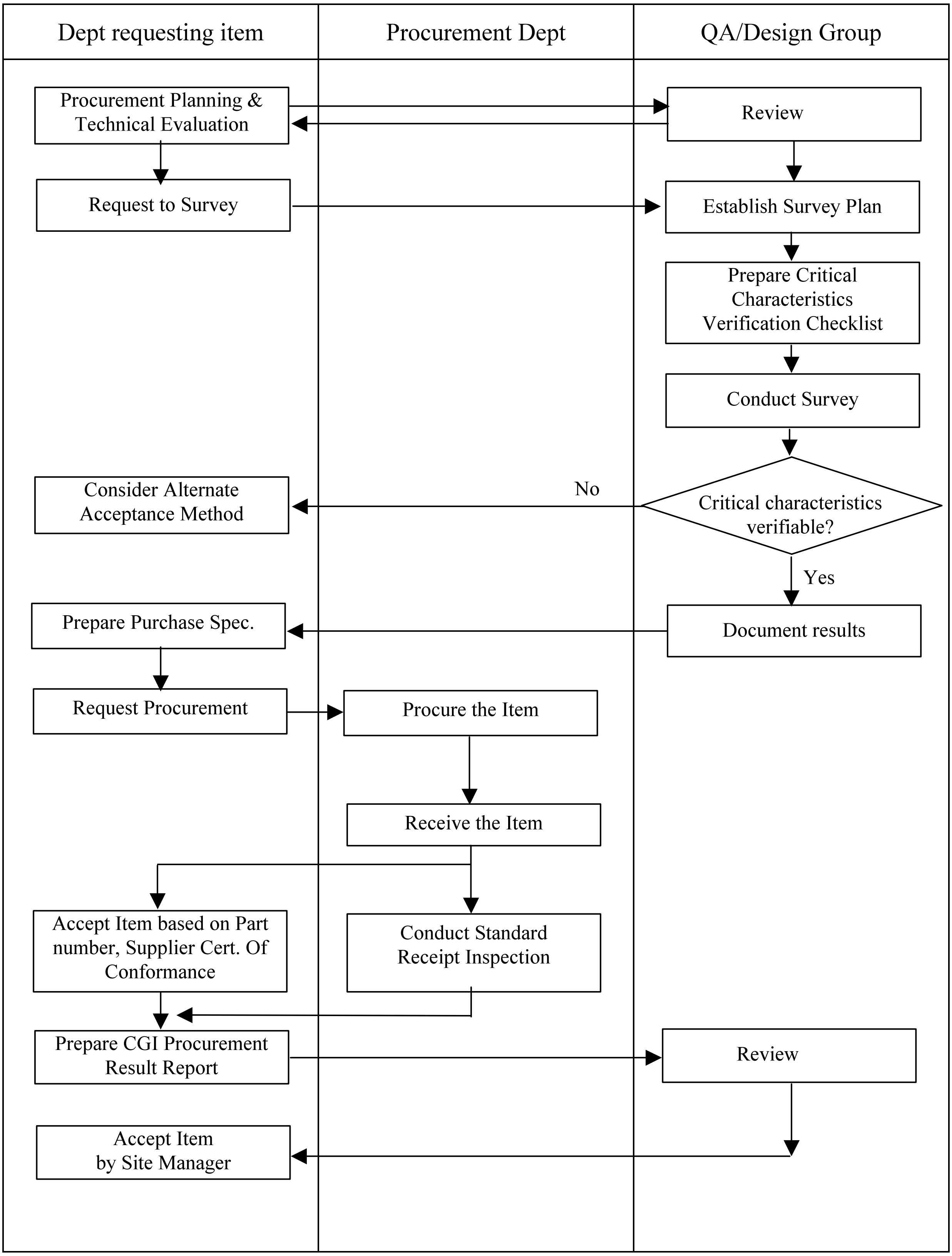
    - Method 1: Special Tests and Inspection
    - Method 2: Commercial Grade Survey of Supplier
    - Method 3: Source Verification
    - Method 4: Acceptable Supplier/Item Performance Record

Details of the flowcharts describing the processes for the different acceptance methods follow below.

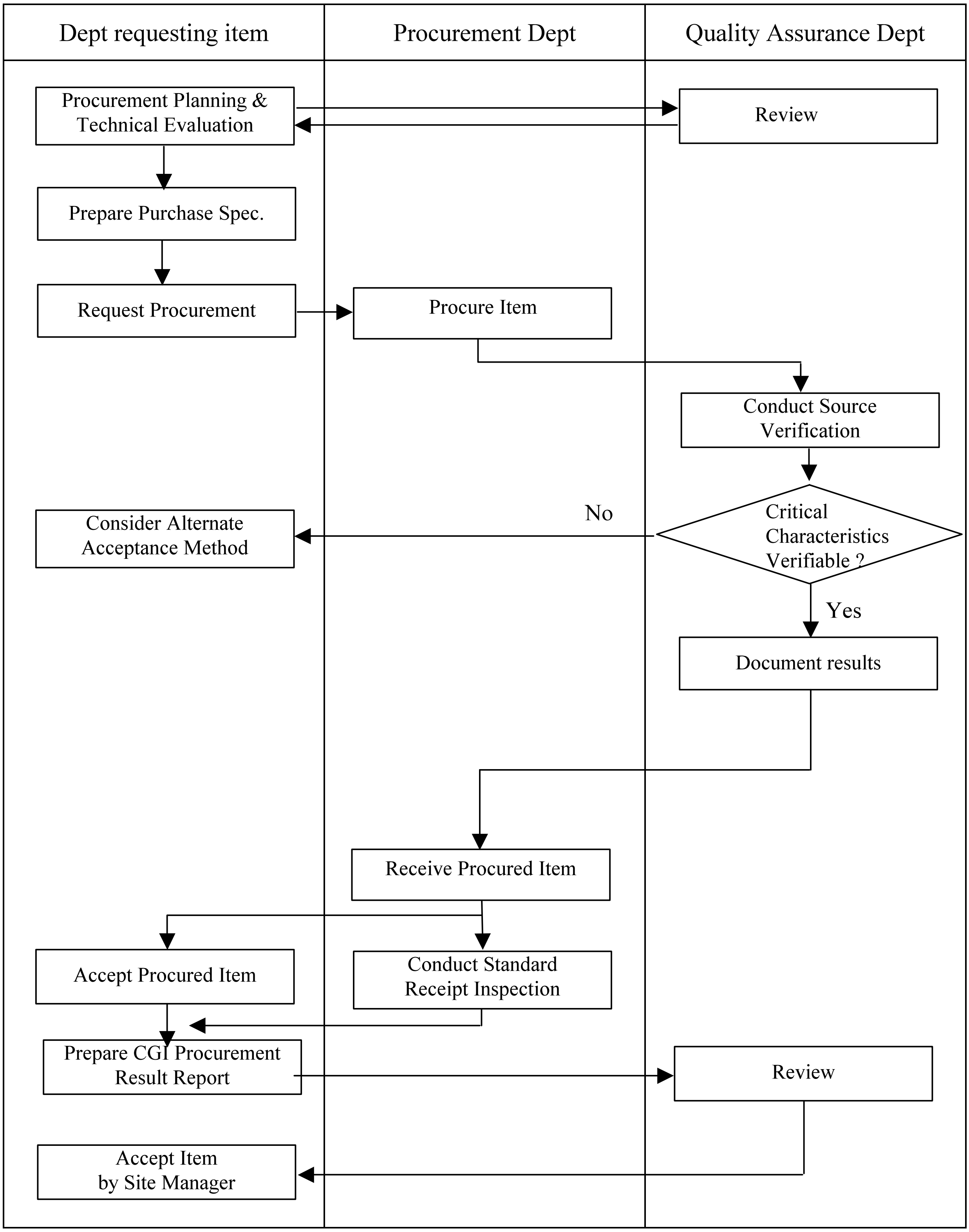
Method 1: Special Tests and Inspections



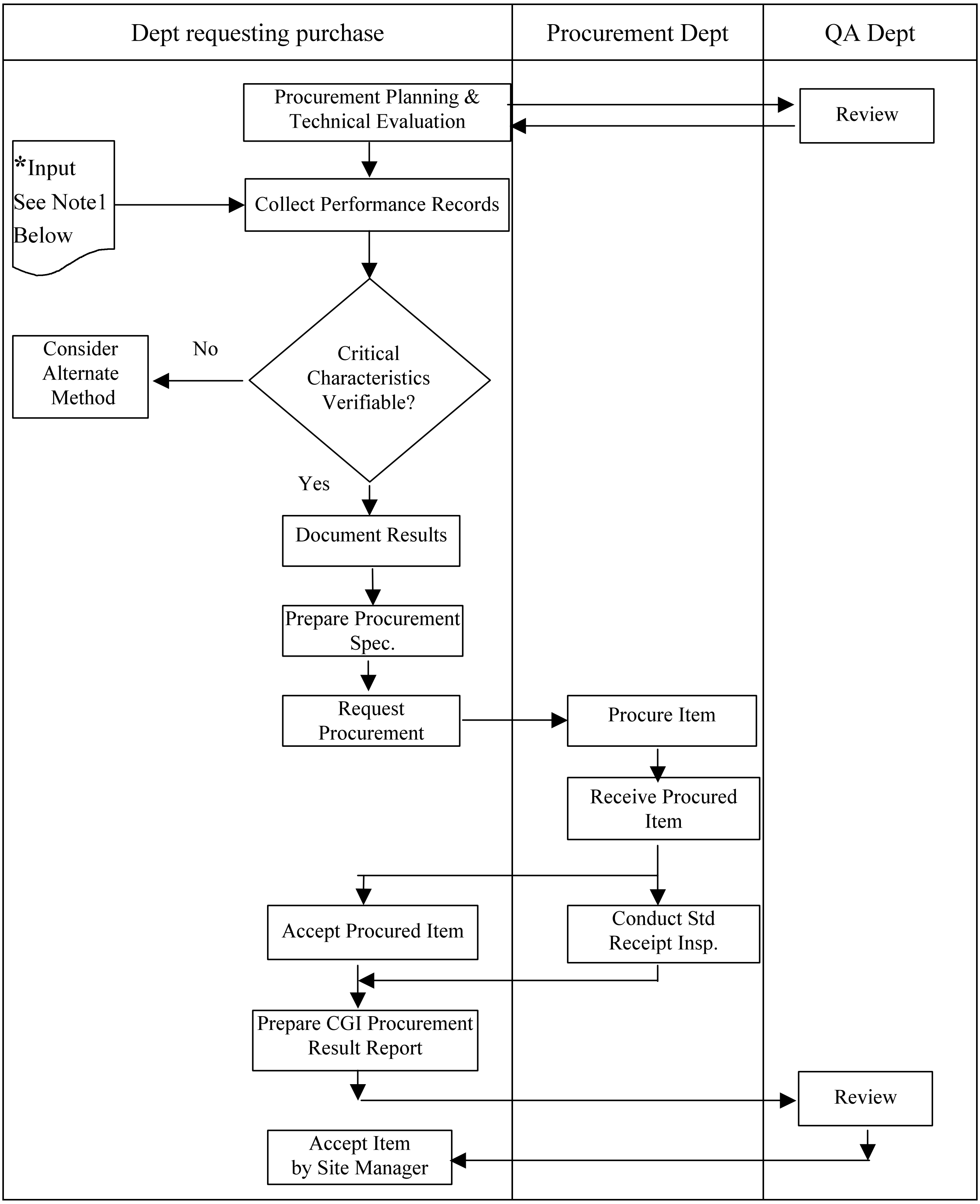
Method 2: Commercial Grade Survey of Supplier



Method 3: Source Verification



Method 4: Supplier/Item Performance Record



*Note 1 Input data from:

NPP Historical Performance/Evaluation Data:
- Results of Monitored Performance of Item
- Periodic Maintenance & Surveillance Tests
- Results from employing Method 1, 2, 3

Industry-Wide Performance Data:
- Verified Performance Test Records
- Seismic Experience/Test Databases & Equipment Qualification
- Industry-wide Utilization
- Regulatory Documents
- Other Related Records

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