APPLICATION OF THE COMMERCIAL GRADE ITEM (CGI) DEDICATION PROCESS FOR PROCUREMENT OF NUCLEAR SAFETY RELATED ITEMS AT NUCLEAR POWER PLANT KRŠKO (NEK)

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Abstract

CGI procurement is a process whereby parts are bought without imposing Appendix B Quality Assurance requirements on the supplier, and then dedicated for use in safety-related applications. The dedication process involves 1) based upon required safety function, an engineering evaluation to identify critical characteristic of the item and specification of acceptance criteria; and 2) quality control activities to ensure the item(s) supplied meets the acceptance criteria specified.

CGI Dedication supports the supply of certified components/parts for the plant operation in an environment where the number of nuclear qualified suppliers diminishes. It requires a more active role of the plant personnel, therefore presenting an additional burden on human resources, but at the same time increases the technical KNOW-HOW and improves the confidence of test and inspection data presented in the certificates. Very often it is also cost beneficial.

This paper is a continuation to last year presentation of the introduction of this method into NEK’s procurement process and presents the current approach and some practical examples.

Introduction

In order to properly describe the process of commercial grade items dedication and utilization in NEK nuclear safety-related applications we must understand the definition of the term CGI (commercial grade item) and the background for that definition.

Commercial Grade Item as defined in 10CFR21 Rev.1 1978 is an Item satisfying ALL three criteria:

- Not subject to design or specification requirements that are unique to nuclear facilities; and
- Used in applications other than nuclear facilities; and
- Is to be ordered from the manufacturer/supplier on the basis of specifications set forth in the manufacturer's published product description (for example Catalog).
Commercial Grade Item as clarified by Nuclear Energy Institute (NEI, former NUMARC)

- An item is a commercial grade item if its critical characteristic can be verified during dedication process.

In the developed programs and procedures the above definitions and clarifications were adopted and NEK specifies commercial grade item as an item whose critical characteristic can be verified during the dedication process and has no nuclear specific requirements, is purchased “off the shelf” (catalogue shopping) and generally used by the industry.

**Dedication**

Dedication is an acceptance process undertaken to provide reasonable assurance that a commercial grade item to be used as a basic component will perform its intended safety function and, in this respect, is deemed equivalent to an item designed and manufactured under a 10CFR Part 50, Appendix B, quality assurance program. This assurance is achieved by the purchaser through identifying the critical characteristic of the item and verifying their acceptability by inspections, tests or analysis.

The dedication of the commercial grade item should not be mixed with the qualification process. The dedication process serves to verify that the item received is the item required (purchased). The qualification process serves to demonstrate and verify that the item will perform it’s designed function.

![Dedication Process Diagram](attachment://dedication_diagram.png)

**Technical evaluation**

For determination of the critical characteristics and acceptance methods and criteria, NEK procedures were developed and are utilized for “Item Functional Safety Classification”, “Like for Like”, “Equivalency” & “Material Substitution” evaluations.
Acceptance process

NEK Procedure “Specification and Dedication of Commercial Grade Items” (ESP-2.207) sets for the NEK acceptance process practices through the following methods:

- Special tests and inspections Method 1
- Commercial grade survey Method 2
- Source verification Method 3
- Supplier/item performance record Method 4
- Combination of two or more of the four methods

These are four different ways to verify critical characteristic as developed by EPRI and endorsed by NRC. The optimal method(s) is selected based upon the technical evaluations, vendor available data and if available equipment performance history data. Because of lack of historical data Method 4 is currently not recommended as an acceptance process at NEK but it can be used for sampling plan optimization when commodity items are purchased as CGI and are subject to a statistically based dedication acceptance process.

Implementation

During the development and introduction phase the following activities were performed:

Establishing of Policy and Strategy
ED-10 “Program for the procurement and dedication of commercial grade items” (1996.) sets for the NEK commitments in CGI utilization.

Tool developing
PROCEDURES ESP-2.201, 2.202, 2.207 and 2.211 (1996.)
MIS computer applications - SCM and PSM (1997)

Personnel training
EPRI Nuclear Procurement Training (1996.)

Appointing of CGD coordinators
TO.VZ disciplines, SKV QA & QC, ING.MOD & ING.POD (1996)

Surveys
Survey of Slovenian laboratories (1996)
Survey of NEK resources (1996)

These activities were performed with internal resources except the development of ED – 10 and procedure review (EPRI CGID Report & Guideline Project Manager), training (EPRI Licensed Instructor) and survey of local capabilities (Electro Institute Milan Vidmar) for a total cost of 60 000 $. This investment had a very fast return in cost savings obtained in the initial purchase orders (e.g. see examples).
NEK experience

Responsibility for preparation of the CGID packages, coordination between internal & external resources involved in CGID process and final approval of CGID packages remains with the Engineering Support Department (ING.POD).

In order to support the introduction of CGID at USA nuclear power plants a Joint Utility Task Group was initiated through EPRI (JUTG) with the purpose of standardizing the methodology (Nuclear Energy Institute Strategy), preparing initial guidance and supporting documents.
NEK used the same concept, methodologies and incorporated "lessons learned". Especially helpful were the item generic EPRI CGI Joint Utility Task Group Commercial Grade Item Templates (total 139).

For every complex item type to be dedicated a generic Instruction is developed which outlines the required inspections and tests.
For every purchase order item a specific dedication plan is prepared. The plan includes:

- safety function
- critical characteristics
- acceptance method and criteria
- sampling plan
- internal & external resources

Technical evaluations, specifications, design data, drawings, product catalogs and all other resources and information sources are utilized.

Using NEK resources and domestic support from June 1996 until April 1998, 10 generic instructions and 70 dedication packages were prepared and implemented. They included among others: relays, terminal lugs, fuses, various types of gaskets and o-rings, seal retainers, various types of bearings, valve stems, pump impellers etc.

Examples:

I. FUSE
II. RELAY
III. DIAPHRAGHM

I. FUSE FNM-1  LICO/BUSSMAN  CGD-96-005-AM

**Item Description:** FUSE  **NEK Part Number:** FNM-1
**Supplier/Manufacturer:** LICO/BUSSMANN
**Supplier/Manufacturer Part number:** FNM-1
**End-use(s) (NEK component ID's):** 125 VDC Panels No. DCT%
**Quantity of CGI's in lot being accepted/dedicated:** 400

**Prepared CGID package includes:**

- Instructions for inspection and acceptance testing of Fuses
  No. IIT-96-001-ZG Rev.0
Safety Functions:

A fuse must carry the design basis load current(s) without interruption. Interruption of the current would adversely affect the function of any safety-related equipment downstream of the fuse. Additionally, the fuse may be required to isolate a fault or overload condition to prevent degradation of the 1E circuit.

Critical Characteristics:

- **Marking and Identification**: Manufacturer BUSSMAN; DUAL ELEMENT; Manufacturer Part Number FNM-1;
- **Dimensions**
  - Overall Length: 38.1mm ± 0.76mm
  - Outside diameter of ferrule: 10.3mm ± 0.15mm
- **Current carrying capacity**: 110% rated current (15 min. minimum)
- **Current clearing time**: 135% rated current (60 min.)
  - 200% rated current (2 min.)
- **Resistance**: 0.35 Ω - 0.45 Ω

EPRI Acceptance Method

**Method 1** - Special tests and inspections (during receipt)

Sampling Plan

**Visual Inspection including**

- **Marking and Identification**: 100%
- **Dimensions**: 32 items
- **Current carrying capacity**: 32 items
- **Current clearing time**: 6 items
- **Resistance**: 100%

Acceptance results:

Tests and inspection were performed in accordance with the sampling plan and 2 fuses were found with failures (100% inspections - lose ferrule and resistance out of tolerances). These 2 fuses were rejected.

Resources:

All Critical Characteristic have been verified with internal resources.

Price comparison:

- **Basic component**, HUB inc., Offer #034.90.1, 05.02.90, price/item: 31 $
- **CGI**, LICO, PO #NEK-3569, 31.06.96, price/item: 2 $

**External resources costs**: price/item: 0 $

**Internal resources costs**: price/item: 6 $

**Cost benefit**: (31 - 8) * 400 = 9200 $
II. RELAY, Control, Type NBFD22S  MERIDIAN  CGD-97-001-AG

Item Description: RELAY, CONTROL (ANTY-PUMP), TYPE NBFD22S, 250 DC, COIL 125/130 VDC, CONTACT 1,1 AMP

NEK Part Number: NBFD22S
Supplier/Manufacturer: MERIDIAN ELECTRIC/WESTINGHOUSE
Supplier/Manufacturer Part number: NBFD22S
End-use(s) (NEK component ID's): 6.3 kV Type 75-DHP-500 CIRCUIT BREAKERS
Quantity of CGI's in lot being accepted/dedicated: 5

Prepared CGID package includes:

- Instructions for inspection and acceptance testing of Relays-Control No. IIT-97-001-ZG Rev. 0
- Commercial Grade Evaluation/Dedication Plan No. CGD-97-001-AG
- Sampling Plan No. SSP-97-001-AG

Safety Functions:

Safety function of the relay is to enable closing of the circuit breaker. Safety function is performed through relay's normally closed contact, which is part of breaker's starting circuit. Normal function of the relay is to prevent breaker's multiple closing, in the case of continuous starting signal.

Critical Characteristic:

Manufacturer and P/N : Westinghouse, Manufacturer Part Num. NBFD22S
Nameplate data (model rating): Manufacturer Catalog Page - 1
Configuration (Contact arrangement): Manufacturer Catalog Page - 3
Dimensions:

<table>
<thead>
<tr>
<th>W</th>
<th>D</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 11/16&quot;</td>
<td>3 1/8&quot;</td>
<td>4 1/32&quot;</td>
</tr>
</tbody>
</table>

Contact movements: free moving, no sticking
Pick-up Dropout Voltage: Pick-up: 90 VDC, Dropout: 80 VDC
Insulation integrity: 1500 Vrms, no break
Contact operation: Continuity, No Continuity
Coil Resistance: 1000 Ω ± 10%

EPRI Acceptance Method:

Method 1 - Special tests and inspections (during receipt)

Sampling Plan

All Critical Characteristic have been verified on all 5 items 100%, except Insulation Integrity, where sampling was utilized (3 of 5 items were tested).

Acceptance results:

All 5 items have passed the tests and inspections.
Resources:

All Critical Characteristic have been verified with internal resources, except Insulation Integrity, where testing was performed by Electro Institute Milan Vidmar, Ljubljana.

Price comparison:

<table>
<thead>
<tr>
<th>Component</th>
<th>Supplier/Manufacturer</th>
<th>Part Number</th>
<th>Price/Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic component</td>
<td>Westinghouse</td>
<td></td>
<td>1559 $</td>
</tr>
<tr>
<td>CGI</td>
<td>MERIDIAN ELECTRIC Inc.</td>
<td>JPO #NEK-5417,19.02.97</td>
<td>68 $</td>
</tr>
<tr>
<td>Internal resources</td>
<td></td>
<td></td>
<td>200 $</td>
</tr>
<tr>
<td>External resources</td>
<td></td>
<td></td>
<td>300 $</td>
</tr>
</tbody>
</table>

Cost benefit: $(1559-68)*5 - (5*200 + 3*300) = 5555 $

III. Diaphragm BR100TNK SAVA KRANJ CGD-96-005-AZ

Item Description: DIAFLOTE DIAPHRAGM NEK Part Number: BR100DIA
Supplier/Manufacturer: SAVA-KRANJ
Supplier/Manufacturer Part Number: BR100DIA
End-use(s) (NEK component ID's): BR100TNK-001 & 002
Quantity of CGI's in lot being accepted/dedicated: 2

Prepared CGID package includes:

- Equipment Spec. G545, rev 0
- Commercial Grade Evaluation/Dedication Plan No.CGD-96-005-AZ

Safety Function:

Diaphragm must prevent air from dissolving in the water and prevents the hydrogen and fission gases in the water from mixing with the air.

Critical Characteristic:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforcement material chemical</td>
<td>Polypropylene</td>
</tr>
<tr>
<td>composition:</td>
<td></td>
</tr>
<tr>
<td>Coating compound chemical composition</td>
<td>Natural Rubber 75-95 MV</td>
</tr>
<tr>
<td>Total weight:</td>
<td>1668+/-170 g/mE2</td>
</tr>
<tr>
<td>Gauge/thickness:</td>
<td>1.9+/-0.24 mm</td>
</tr>
<tr>
<td>Tensile strength:</td>
<td>min.1325x880 N/5cm</td>
</tr>
<tr>
<td>Gas permeability (He):</td>
<td>less than 4x10E-4 mbar l/s</td>
</tr>
<tr>
<td>Configuration/dimensions:</td>
<td>per Manufacturer drawing #66864-502</td>
</tr>
<tr>
<td>Leak test:</td>
<td>p=30cm v.st. const. per 4h</td>
</tr>
</tbody>
</table>

EPRI Acceptance Method:

- Method 2 - Commercial Grade Survey
- Method 3 - Source Verification
Sampling Plan:

All Critical Characteristics have been verified on 2 purchased items – sample 100%

Acceptance Results:

All purchased items have been manufactured in accordance with Technical Specification SP-G545, Rev.0 and applicable procedures for fabrication, testing and inspection. All test/inspections reports and results have been accepted and in accordance with original design parameters.

Resources:

All Critical Characteristics have been verified with internal resources.

Price comparison:

<table>
<thead>
<tr>
<th>Basic component</th>
<th>PGS Proposal 009.94, dated June 13, 1994, price/item: 80 000 $</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGI,</td>
<td>SAVA-KRANJ Ponudba, 28.6.1994., price/item: 60 000 $</td>
</tr>
<tr>
<td>External resources costs:</td>
<td>0 $</td>
</tr>
<tr>
<td>Internal resources costs:</td>
<td>10 000 $</td>
</tr>
<tr>
<td>Cost benefit:</td>
<td>((80\ 000 - 60\ 000) \times 2 -10\ 000 = 30\ 000)$</td>
</tr>
</tbody>
</table>

NOTE: Some activities performed with internal resources are a one-time issue (Instruction & Plan development) and therefore an increased cost benefit is to be anticipated in future procurements.

Lessons learned

During the development phase, based upon the experience at USA Nuclear Power Plants, NEK established *early phase limitations/prerequisites*:

- Simple items
- Qualified product not available
- Not above, but the following can be fulfilled (design data, acceptance criteria available):
  - Identified critical characteristic (including seismic) can be verified against known acceptance criteria
  - Test/inspection equipment and qualified personal is available
  - Significant cost reduction
  - Purchasing to specific application
  - Available resources

This proved to be a wise decision, for the method proved to be efficient with a positive development trend (item complexity and involvement of internal resources – staff, inspection & test methods & equipment) and was not suffocated by starting overambitiously with a too complex item.
The following benefits were identified:

- intensive transfer of know-how,
- increasing awareness of part functions within components,
- full confidence in certifications,
- internal resources development
- cost effectiveness

Conclusion

In the current environment of reduced nuclear vendor support and increased regulatory requirements the Commercial Grade Dedication process has proved to be a viable solution for acquiring nuclear safety related items without specific nuclear requirements (e.g. not applicable for ASME III & XI items).

It is the intent of NPP Krško to increase its usage and continue its gradual development, bearing in mind the still existing limitations and prerequisites:

- Lack of manufacturers data (acceptance criteria, part function within component)
- NEK Laboratory (Clean room) and M&T equipment
- Manpower (resources and expertise)
- Budgeting

References

2. Guidance for the Utilization of Commercial Grade Items in Nuclear Safety-Related Applications, NCIG-07 (NP-5652), EPRI, 1988
3. NRC Generic Letter 89-02, NRC conditional endorsement of EPRI report NP-5652, 1989
4. NUMARC 90-13, Comprehensive Procurement Initiative, 1990
5. NRC Generic Letter 91-05, Licensee Commercial Grade Procurement and Dedication Programs, 1991