PAPER PRESENTED
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"CONFIGURATION MANAGEMENT – NUCLEAR PLANTS"

LATIN AMERICAN SECTION — AMERICAN NUCLEAR SOCIETY

Prepared by:
Mr. Narendra P. Singh – Senior Project Manager
URS Washington Division
Princeton, NJ 08543, USA

Mr. Nag Ramacrandran – CEO,
iSigma, Inc.
Tucker, GA 30084, USA
Configuration Management
How CM can be applied in Nuclear Industry

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Narendra P. Singh
URS Corporation - Washington Division, Princeton (NJ), USA

- Forty-six (46) years engineering, design and project management experience in financial and technical management of major nuclear and fossil fuel generating projects in U.S., Mexico, India and U.K. Four (4) years experience in manufacturing and heavy fabrication industry.

- Currently responsible for URS Corp/Washington Group’s technical support and project development activities for Laguna Verde Nuclear Power Plant in Mexico. These activities include power uprate program, EDMS & Configuration Management system, Plant Modifications & Upgrades, Engineering and technical support.

Overview of URS Corporation

- One of the World’s Leading Engineering and Construction Services Firms
- Approximately 56,000 Employees in More Than 30 Countries
- Proforma Annual Revenue of $9 Billion
- Fully Integrated Services Support Full Project Life Cycle
  - Leader in Engineering, Construction, Facilities Management, and Environmental
  - Serves Federal, State and Local Government Agencies, and Multinational Fortune 500 Companies

Merged in November 2007
URS Corporation
2007 Financial Highlights*

• Gross Revenues: $5.38 billion
• Operating Income: $311.2 million
• Net Income: $132.2 million
• Cash on Hand: $256.5 million
• Shareholders Equity: $3.5 billion
• Backlog: $18.71 billion
• NYSE symbol: URS

* Results include six weeks of operations from the former Washington Group International, Inc.

URS Corporation is the 4th largest publicly held E&C company in the U.S.
Washington Division

• Fully integrated engineering, construction and technical services organization with the capabilities to support the project life cycle—from inception through start-up and operation to decommissioning and closure

• Over 90 years of experience performing projects around the world and throughout the United States

Formed from a Rich Heritage

- Rust
- Isbill
- Litwin
- Kasler
- Ebasco
- Catalytic
- Gibbs & Hill
- HK Ferguson
- Stearns-Roger
- Morrison Knudsen
- Centennial Engineering
- Washington Construction Group
- United Engineers & Constructors
- Westinghouse Government Services
- Raytheon Engineers & Constructors
- Washington Group International
What is Configuration Management (CM)

- Process of Identifying and Documenting
  - Facilities Structure
  - Systems
  - Components

- Process of Changes
  - Follow predefined approved process
  - Assessed
  - Approved
  - Issued
  - Verified
  - Recorded
  - Incorporated in the facility documentation
Configuration Management—Definitions

Definition No. 1
A management process that assures full consistency between existing plant design and licensing requirements and controls changes to ensure that the plant is configured, maintained, operated and managed that is completely in conformance with the design bases and licensing commitments.

Definition No. 2
An integrated set of activities consisting of processes, practices and tools for establishment and subsequent maintenance of the design integrity of a plant throughout its life cycle.

Definition No. 3
An integrated management process involving engineering, construction, operation and maintenance to achieve the ultimate conformance and equilibration between the design requirements/bases, plant documentation and the physical configuration of the facility.
The simplest **definition** of Configuration Management is what we do to assure ourselves and our regulators that we are doing everything we said we would do.

The **objective** of Configuration Management is the conformance of the three elements represented by the CM Equilibrium Model.
Configuration Management Objectives

Design Requirements

Facility Configuration Information

Design Basis

Operating, Maintenance & Procurement Information

Physical Configuration

Must Conform

What is required To be there

Must Conform

What we say is there

Work Processes must ensure that:
Elements conform all of the time
All changes are authorized
Conformance is auditable
Discussion of CM Objectives and Process

- **Design Requirements**: What needs to be there
- **Physical Configuration**: What is actually there
- **Facility Configuration Information**: What we say is there

**CM Equilibrium**

- Evaluate: Identified problem or desired
- Change: Design Requirements
  - Yes: Design Requirements change processes
  - No: Change Physical Configuration
    - Yes: Physical configuration change authorization processes
    - No: Change Facility Configuration Information
      - Yes: Facility Configuration Information change processes
      - No: Do nothing more
Results of Inadequate CM

- Loss of ability to perform safety actions
- Reliability of the plant
- Not having right information at the right time leads to human errors having potential safety consequences
- Expenses which has direct impact on the economic operations of the facility
- Management ownership and support of duplication of the effort
- Worker exposure to radiological and hazards
Current Situation

- Many nuclear power plants, particularly older facilities have not fully consolidated design bases and the relevant documentation
- Disappeared original Documentation
- The original “know-why” is not readily available
- Many modifications have been made but the cumulative effects of the changes have not been consolidated
- The modification and maintenance, management of the plant does not have a high degree of assurance that the facility documentation reflects actual plant status
How Information Technology Can Help?

- Document Management
- Workflow
- Maintain, Manage and Control Configuration
Laguna Verde Nuclear Power Station – Units 1 & 2

Electronic Document Management System
Application Framework

- Document Management
- Security
- Process Monitoring
- Workflow
- Records Management
- Integration Middleware
- Configuration Management
- Electronic Forms
- Application Framework
Document Management

- Document and Records Management
  - Flexible Indexes
  - Searchable Libraries
  - Electronic Document Storage
  - Version Control
Configuration Control

- Configuration Control
  - Interrelationship Management
    - Procedures
    - Specifications
    - Vendor Documents
    - Modification Packages
    - Documents
    - Components
    - Tags
    - Buildings
    - Parts (Inventory)
    - Disciplines
    - Corrective Action Requests
    - QA Controls
    - Regulatory documents
Workflow Management

- Workflow Designer
- Configurable Workflow Routing Mechanism
- Process Administration and Reviews
- Collaboration with Users and Roles
- Electronic Approvals
- Interdisciplinary Reviews
- Dynamic Routing
- Document and Process Audit Archival
Imaging

- Tightly Integrated Image Management
- Electronic Images
- Multiple Layers
- Image Manipulation through browser
- Electronic Forms
- PDF Rendition and Rollup Services
- Support for native format images
Security

- Delegation of Authority
- Electronic PIN Authorization
- Secured Socket Layer SSL
- Role based access to documents and participation in the business processes
- Password Policies
- Encrypted Passwords
External Systems

• Integration with External Systems
  – Inventory and Parts
  – Purchasing
  – Financial Systems
  – Human Resources
  – Inventory and Parts

• Integration using
  – Standard Web Services
  – Direct Database Links
Interface

• Easy to use browser based interface
• Security Controlled Web Pages
• Integrated Electronic Forms
• Client Rich AJAX
C-97 Project at CFE Mexico

- The nuclear power plant in Mexico (CFE) successfully implemented Configuration Control, Document Management Systems and Workflow System

- Key Selection Factors

- Did Market analysis and determined that there is NO out of the box solution readily available in the market to implement the system

- A base document management and work flow engine was selected to be the base repository for documents, images and the driver for the workflow processes
C-97 Project

- Washington International, CFE and iSIGMA, Inc started the process of detailed analysis and integration options and determined that following are the critical building blocks to support the requirements of CFE and built the functionalities:
  - Solid Application Framework
  - Configurable intelligent Forms
  - Bi-Directional relationship capabilities
  - A Driver to monitor and control the workflow process
  - Inter disciplinary reviews and External Reviews
C-97 Project (contd.)

- Analyzed of various types of documents available including hard copy documents
- Prepared detailed practical business process documents - clearly defining the business process
- Detailed analysis of inter relationships between various entities
- Consolidated information from multiple sources
Powerful Library Search

Security insures users can only access what they are entitled to see.

Clicking on Library brings up a list of search classes.

Clicking on a search class brings up the associated query.
Performing a Search

A wide range of operators may be used to specify search parameters.

Users can easily enter search values.

Security insures users can only access what they are entitled to see.
All relevant documents are in the folder and may be accessed easily.

This is the folder returned from the search on the previous slide.

All related indexing data is available as part of the folder.
Content Services

- View, Edit, and Locking Functions available via permissions.
- Version control is applied to every object.
- Multiple renditions are supported.
Image Manipulation and Viewing

Easy navigation through multi-page documents.

Redaction capabilities through various shapes.

Highlight and annotation capabilities.

Markups to draw attention to or highlight a specific section.
Integration with Microsoft Office

Word integration with documents managed by System.

Outlook integration with documents managed by System.

These documents are stored in the System system.
Process Modeling (Workflow)

- Each icon represents a queue where work is processed.
- Workflow shapes are dragged and dropped to the palette.
- Connectors represent the flow of work under predefined rules.
Building Workflow Rules

Sophisticated decision and routing logic are easily defined.

Escalation notification can be done via email.

Notification of work assignment can be done via email.

Sophisticated exception processing and escalations are easily defined.
Each work item contains all required data and content required for processing.

Work item fields can be automatically created upon capture.
Workflow Audit Trial

Tracks all events that occur during task processing.

Provides a time/date stamp of all activity.

Tracks who worked on the workflow item.
## Portfolio Views

### Control de la Configuración

#### Vendedor

<table>
<thead>
<tr>
<th>N° de Documento</th>
<th>00001</th>
<th>Versión</th>
<th>02 (†-Vigente)</th>
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</table>

**Observaciones:**

- Actualizar cuando se cambie la Sta. Adherencia
- A trámite

**Actores:**

- AA
- BB
- CC

**Historial de Cambios:**

- 03/08/2011
  - **Fuente:** Vendedor
  - **Descripción:** Número de inventario actualizado

**Destino:**

- AA

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**Anexo:**

- **Proveedores:**
  - Electroventilación Ind.""
Technology

- FYI Core Workflow Engine
- SQL Server / Oracle – Data Repository
- Cold Fusion – Web server and Data Access
- XML / XSL Frame Work – Presentation and Web Services
- VB / .net
- Crystal Reports - Reporting
Solutions can be applied to
## Configuration Management

### Reference Documents

<table>
<thead>
<tr>
<th>Category</th>
<th>Document ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANSI Standards</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANSI/NIRMA CM 1.0</td>
<td>Configuration Management of Nuclear Facilities</td>
<td></td>
</tr>
<tr>
<td>ANSI/ANS 3.2-1994</td>
<td>Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants</td>
<td></td>
</tr>
<tr>
<td>ANSI N18.7-1976</td>
<td>Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants</td>
<td></td>
</tr>
<tr>
<td>ANSI N45.2.9-1974</td>
<td>Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants</td>
<td></td>
</tr>
<tr>
<td>ANSI N45.2.11-1974</td>
<td>Quality Assurance Requirements for the Design of Nuclear Power Plants</td>
<td></td>
</tr>
<tr>
<td><strong>DOE Standards</strong></td>
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</tr>
<tr>
<td>DOE-STD-1073-2000</td>
<td>Configuration Management</td>
<td></td>
</tr>
<tr>
<td><strong>EPRI Documents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR-103586-R1</td>
<td>Guidelines for Optimizing the Engineering Change Process for Nuclear Power Plants</td>
<td></td>
</tr>
<tr>
<td><strong>IAEA Documents</strong></td>
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</tr>
<tr>
<td>IAEA-TECDOC-1335</td>
<td>Configuration Management in Nuclear Power Plants</td>
<td></td>
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<tr>
<td>Draft Safety Report</td>
<td>Application of Configuration Management to Nuclear Power Plants</td>
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<tr>
<td>Draft TECDOC Guidance for Design Basis Documents in Soviet VVER plants</td>
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</tbody>
</table>
Configuration Management
Reference Documents

INPO Documents
INPO 87-006  Report on Configuration Management in the Nuclear Utility Industry
INPO 05-003  Performance Objectives and Criteria (May 2005) Section II
INPO AP-929  Configuration Control Process Description Revision I

NEI Documents
NEI 96-07 Rev 1  Guidelines for 50.59 Evaluations
NEI 97-04, Rev 1  Design Basis Program Guidelines Design bases as defined in the 10CFR50.2 (see Reg. Guide 1.186 & NUMARC 90-12)
NEI 98-03  Guidelines for Updating Final Safety Analysis Reports

Position Papers
PP02-1994  Configuration Management • Defines CM
PP03-1992  Implementing CM Enhancement in a Nuclear Facility
PP04-1994  Configuration Management Information Systems

Technical Guidelines
TG11-1998  Authentication of Records and Media
TG13-1986  Records Turnover
TG14-1992  Support of Design Basis Information Needs
TG15-1998  Management of Electronic Records
TG16-1998  Software Configuration Management and Quality Assurance
Technical Guidelines (cont’d.)
TG17-1993 Management of Nuclear Training Records
TG18-1994 Guideline for Implementing VTIC Programs
TG19-1996 Configuration Management of Nuclear Facilities
TG20-1996 Drawing Management Program Principals and Processes
TG21-1998 Electronic Records Protection and Restoration
TG22-1999 Identifying Quality Assurance Records (Draft)

NRC Documents
GL 88-18 Plant Record Storage on Optical Disks.
Reg. Guide 1.186 Design Basis Information
RIS 00-18 Guidance on Managing Quality Assurance Records in Electronic Media
10CFR50 Configuration Management 50.2 Definitions 50.54(f): 50.59 Changes: 50.71 Maintenance of Records: Appendix A General Design Criteria
Number of Planned Reactors (34)

Vendor Technology Under Consideration

- **General Electric**
  - Advanced Boiling Water Reactor (ABWR), 1,356 MWe *(certified 10CFR52 App A)*
  - Economic Simplified Boiling Water Reactor (ESBWR), 1,560 MWe

- **Westinghouse**
  - Advanced Passive Pressurized Water Reactor (AP1000), Twin units 1,117 MWe each *(certified 10CFR52 App D)*

- **AREVA**
  - United States Evolutionary Pressurized Water Reactor (US EPR), 1,600 MWe

- **Mitsubishi Heavy Industry**
  - United States Advanced Pressurized Water Reactor (US APWR), 1,700 MWe
Quick Statistics

- Early Site Permits issued—3
- Permits under review—1
- Total COL applications submitted—9
- COL applications docketed—8
- Certified reactor designs—2
- Reactor designs under review—4
- Expected license applications—23
- Expected number of reactors—34
- Nuclear plant locations—20
- Companies applying for COL—20
Margin Limits

- Design Basis
- Design Requirements
- Operational Configuration

- Ultimate Capability
- Analyzed Design Limit
- Operating Limit
- Range of Normal Operation

- Analytical Margin
- Design Margin
- Operating Margin
INPO Margin Model

- Analyzed Design Limit
- Operating Limit
- Design Margin
- Operating Margin
- Range of Normal Operation
- Unanalyzed Margin
- Equipment/Function Failure
IRS Data

• Incident Reporting Systems data shows
  – Errors in original design or design modifications
  – Inadequate corrective actions
  – Inadequate testing
  – Documentation discrepancies
Principles of a CM

- CM is a management discipline that applies technical and administrative direction to
  - Development
  - Production
  - Support life cycle
- Applicable to
  - Hardware
  - Software
  - Processed materials
  - Services
  - And related technical documentation
- CM is an integral part of life-cycle management
Document Management

• Categorization of Documents
• Index, Digitize and Store Documents
• Version Control
• Check-in Checkout
Workflow

- Automation of many business processes results in the elimination of many unnecessary steps
- Improved management of business processes achieved through standardizing working methods and the availability of audit trails
- Improved Consistency in the processes leads to greater predictability in levels of response to customers
- Flexibility – software control over processes enables their re-design in line with changing business needs
- Streamlining and simplification of Business Process
Configuration Control

• Maintain bi-directional relationships with
  – Systems
  – Facilities
  – Components
  – Documents
    • Design Documents
    • Tech Specs
    • Vendor Manuals
    • Drawings
    • Procedures