TVA’s Approach to Retaining Critical Knowledge in an Aging Workforce

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Managing Nuclear Knowledge

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Manager, Work Force Planning
Tennessee Valley Authority

Agenda

Background and Overview
• TVA’s Attrition Challenge
• Integrated Staffing Plan
• Retaining Critical Knowledge
  – Knowledge Retention Initiative
  – Application of KR at Sequoyah Nuclear Plant
  – Lessons Learned

Application of Knowledge
Retention
Who is TVA?

- America’s largest public power producer
- Through a network of 158 municipal and cooperative power distributors
- 8 million customers; 7 states
- 12,800 Employees
- Capacity – 31,000 MW
  - 3 nuclear plants
    - Five units; 5,683 megawatts
  - 11 coal-fired plants
  - 29 hydroelectric dams
  - 1 pump storage facility

The Attrition Challenge

Significant downsizing 1988 – 1997

- From 28,000 to Less Than 12,800 Employees
- TVA Nuclear from 13,900 to Less Than 2,900
- Very Limited Entry Level Recruiting
- Various Retirement Incentives to Aid Downsizing
TVA’s Approach to Retaining Critical Knowledge in an Aging Workforce

The Attrition Challenge

- Average Age – approximately 47
- 1/3 can retire within next 5 years
- Timing Replacements??????
- Manage Labor Cost

Integrated Staffing Plan

Developed in 1998, TVA’s Integrated approach to Staffing includes:

- Work Force Planning
- Recruiting Initiatives
- Training Pipeline
- Key Leadership/Succession Planning
- Knowledge Retention
Recruiting Initiatives

- College Recruiting
  - Eight Targeted Universities
  - In Valley Recruiting (helps retention)

- Maintenance and Operations Pipeline
  - Majority entry level trainees – 2 year degree required in technical area – EEI Testing
  - Supplement Maintenance with experience/journey level as needed
  - Navy Nuclear as available in Ops

- Professional/Experienced Recruitment to Ensure Adequate Bench strength

The role of pipeline training and multi-skilling in knowledge transfer

- Increased entry-level requirements and shorter training programs (2.5 vs 4 years) - Most require 2 year Technical Degree & EEI Test
- Use craft instructors/subject matter experts (SMEs)
- Use benchmarking to improve programs - faster to work
- Cross train incumbent employees- Multi-skilling
- Use of retirees as instructors and SMEs
Knowledge Retention Initiative

8 Knowledge Management Strategies

- External Best Practice Sharing
- Internal Best Practice Sharing
- Competitive Intelligence (CI)
- Knowledge of Customers
- Innovation & Creation of New Knowledge
- Intellectual Capital and CI Protection
- Avoidance of Knowledge Loss Through Attrition
- KM Information Technology Tools
TVA’s Approach to Retaining Critical Knowledge in an Aging Workforce

Knowledge Retention

Process Focus

• Focusing on the critical positions where knowledge loss is the greatest threat

• Identifying and prioritizing the specific knowledge and skills at risk

• Developing concrete, actionable responses to mitigate this loss.

Knowledge Retention

TVA’s Knowledge Retention Process - Retaining Critical Knowledge

Three main subprocesses/activities:

Step 1. Conduct a Knowledge Loss Risk Assessment

Step 2. Determine Approach to Capture Critical Knowledge

Step 3. Monitor and Evaluate
"Knowledge Loss Risk Assessment"

- The "Knowledge Loss Risk Assessment" is designed to identify positions/people where the potential knowledge loss is greatest and most imminent.
- Includes Ratings based on two factors:
  - Time until Retirement
  - Position Criticality
- Provides focus - Identifies positions where steps to mitigate knowledge loss may be needed.

Knowledge Retention

![Diagram showing steps and factors]

Retirement Factor  X  Position Risk Factor = Total Attrition Factor

Retirement Factor -- The projected retirement dates in the work force planning system (whether based upon employee estimates or calculated based on age and tenure data) will be assigned a retirement factor as follows:

- 5 - Projected retirement date within current or next fiscal year
- 4 - Projected retirement date within 3rd fiscal year
- 3 - Projected retirement date within 4th fiscal year
- 2 - Projected retirement date within 5th fiscal year
- 1 - Projected retirement date within or greater than 6th fiscal year
"Knowledge Loss Risk Assessment"

Step 1: Retirement Factor

Step 2: Position Risk Factor

Step 3: Total Attrition Factor

Position Risk Factor -- An estimate of the difficulty or level of effort required to replace the position incumbent. Managers/supervisors are responsible for making these ratings based upon the following criteria:

5 - Critical and unique knowledge and skills. Mission-critical knowledge/skills with the potential for significant reliability or safety impacts. TVA- or site-specific knowledge. Knowledge undocumented. Requires 3-5 years of training and experience. No ready replacements available.

4 - Critical knowledge and skills. Mission-critical knowledge/skills. Some limited duplication exists at other plans/sites and/or some documentation exists. Requires 2-4 years of focused training and experience.

3 - Important, systematized knowledge and skills. Documentation exists and/or other personnel on-site possess the knowledge/skills. Recruits generally available and can be trained in 1 to 2 years.

2 - Proceduralized or non-mission critical knowledge and skills. Clear, up-to-date procedures exist. Training programs are current and effective and can be completed in less than one year.

1 - Common knowledge and skills. External hires possessing the knowledge/skill are readily available and require little additional training.

Total Attrition Factor -- An estimate of the effort and urgency necessary to effectively manage the attrition.

20-25 High Priority - Immediate action needed. Specific replacement action plans with due dates will be developed to include: method of replacement, knowledge management assessment, specific training required, on-the-job training/shadowing with incumbent.

16-19 Priority - Staffing plans should be established to address method and timing of replacement, recruitment efforts, training, shadowing with current incumbent.

10-15 High Importance - Look ahead on how the position will be filled/ work be accomplished. College recruiting, training programs, process improvements, reinvestment.

1-9 Important - Recognize the functions of the position and determine the replacement need.
Knowledge Retention

“Determine Approach to Capture Critical Knowledge”

- Conduct Interview to ID potential knowledge loss areas
- Assess consequences of loss using interview results and organization specific critical skills inventories
- Prioritize and ID options to retain or mitigate
- Develop and implement action plans

Conduct Interview to ID potential Knowledge Loss Areas

Interview Questionnaire

- General questions
- Task questions (how…)
- Fact or information questions (what…who…)
- Pattern recognition / lessons-learned questions

Interview Questionnaire

Identifying At-Risk Knowledge

Instructions

The purpose of the questionnaire is to identify your critical skills and knowledge. Ideally, there will be knowledge loss when you leave TVA. Some things should be easy to identify and others may not be.

Knowledge will not always mean different things. We want to ask you helpful questions that will help us capture the key information you need to know. You may want to think of these questions in general.

The purpose of the questionnaire is to help you identify your critical skills and knowledge. Ideally, there will be knowledge loss when you leave TVA. Some things should be easy to identify and others may not.

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Knowledge Retention

Assess the Consequences and Develop Plan

- What is the relative importance of this knowledge item?
- What is the rarity of the knowledge item?
- What is the difficulty (cost and feasibility) of recovery for this knowledge loss item?
- Develop & Implement Knowledge Retention Plan

**ID Options to Retain or Mitigate Knowledge Loss**

**Codification**
- Documentation & Procedures
- Checklists, Inventories, etc.
- Performance Support Systems
- Concept Mapping

**Alternative Resources**
- Agency/site/department expert
- Rotational or “Visiting” Staff
- Multi-skilling or Cross-training
- Contractors, part-timers, retirees

**Engineer It Out**
- Process Improvement
- Update Equipment
- “Smart” tools and technology
- Eliminate task, product or service

**Education & Training**
- Classroom and Simulator Training
- CBT, Video-based, and alternative delivery
- Coaching and Mentoring
- OJT and Targeted Work Assignments
- Coaching, Shadowing and Mentoring
- Apprenticeship Programs
TVA's Approach to Retaining Critical Knowledge in an Aging Workforce

Knowledge Retention

**Monitor and Evaluate Knowledge Retention Plans**

- Review updated Work Force Planning Attrition Data - *Annually during Business Planning*
  - Review previous Knowledge Retention Plans
  - ID areas that need to be reassessed (*Repeat Conduct Knowledge Loss Risk Assessment - Step 1*)
- Quarterly Work Force Reviews (Succession Planning Meeting)
- Bi-Annual Leadership Review Meetings

**End Overview**
Implementation of TVA’s Knowledge Retention Process at Sequoyah Nuclear Plant

Sequoyah Nuclear Plant – Quick Facts

- 2-Units / 2320MW
- 4-loop, Westinghouse designed PWR with Ice Condenser Containment
- Commercial Operation, 1981 (Unit 1)
- 852 Employees
- Contractors for security, etc . . .
Sequoyah KR Demographics

**Status/Results of Assessments:**
- All employees have been assessed and have a “Score” (851 current employees)
- 10 “High Priority” KR Action Plans initially developed
- 4 “High Priority” KR Action Plans currently being monitored

**Breakdown of Assessments:**
- 4 “High Priority”
- 12 “Priority”
- 136 “High Important”
- 699 “Important”

Sequoyah Nuclear Plant: KR Update

**Background/History**
- First KR assessment November, 2003 - initially identified 10 “High Priority” candidates
- Internal consultant conducted interviews with all 10 candidates – Develop Action Plans
- Of 10 initially identified as “High Priority” 4 are still considered as “High Priority” today
- Disposition of the other 6:
  - **Employee 1, Civil Engineer**: Moved retirement date 2 years out, which moved score to a less priority
  - **Employee 2, Rad. Chemist**: Moved retirement date 4 years out, which moved score to a less priority
  - **Employee 3, Ops Specialist**: Moved retirement date 4 years out, which moved score to a less priority
  - **Employee 4, Maintenance Specialist**: Retired after knowledge loss was captured through Action Plan
  - **Employee 5, Electrical Design Engineer**: Retired after knowledge loss was captured through Action Plan
  - **Employee 6, Mech Maintenance Engineer**: Moved retirement date, which moved score to a less priority
Sequoyah Nuclear Plant: KR Update

**Current State**

- 4 “High Priority” candidates. Plans last reviewed in March 2005:
  - Employee A, Periodic Test Program Specialist: Replacement person hired from outside with turnover in progress. Retire in August.
  - Employee B, System Engineer (Pumps, Valves): Knowledge captured through this process and turnover to in-house personnel. Retirement Dec.
  - Employee C, System Engineer (Primary water side): Knowledge captured through this process and turnover to in-house personnel. Retirement early 2006.
  - Employee D, Electrical Design Engineer: Knowledge captured through this process and turnover to in-house personnel. Retirement in August.

- Sequoyah recently updated attrition information on all employees, surfaced 5 additional names to the potential “High Priority” status. After evaluations and review by the team, determined they were not in the “High Priority” category - Action Plans not needed.

**Immediate Next Steps**

- Develop KR Action Plans for the 5 employees on site with a position risk factor of “Critical”
- Continually evaluate the effectiveness of the program

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**Sample KR Plan – Sequoyah Engineer**

**KNOWLEDGE RETENTION PLAN**

<table>
<thead>
<tr>
<th>Employee</th>
<th>Position: Engr.</th>
<th>Criticality (1-5)</th>
<th>Target Date(s) for Completion</th>
<th>Status and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee A</td>
<td>Mechn. General (NUC)</td>
<td>5</td>
<td>June 2004</td>
<td>To be assigned to T-Pipe training.</td>
</tr>
<tr>
<td>Employee B</td>
<td></td>
<td></td>
<td>June 2005</td>
<td>Will attend T-Pipe training.</td>
</tr>
<tr>
<td>Employee C</td>
<td></td>
<td></td>
<td>Dec 2005</td>
<td>On-going replacements are needed.</td>
</tr>
<tr>
<td>Employee D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Knowledge or Skill Criticality (1-5)**

- 5: Absolutely critical
- 4: Critical
- 3: Important
- 2: Gary
- 1: Not critical

**Criticality**

- 5: Absolutely critical
- 4: Critical
- 3: Important
- 2: Gary
- 1: Not critical

**Knowledge or Skill Criticality**

- 5: Absolutely critical
- 4: Critical
- 3: Important
- 2: Gary
- 1: Not critical

**Actions**

- Identify a replacement person for the critical skills
- Replacement person complete ASME courses in piping analysis and code requirements
- Replacement person develop a working knowledge of T-Pipe Code, ASME Code, procedures and criteria through reading and mentoring of Employee A and Employee B.

**Target Date(s) for Completion**

- June 2004
- June 2005
- Dec 2005
- March 2005
- June 2004
- Oct 2005

**Status and Notes**

- To be assigned to T-Pipe training
- Will attend T-Pipe training
- On-going replacements are needed
- On-going replacements are needed
- To be assigned to T-Pipe training
- Will attend T-Pipe training
- On-going replacements are needed

**Development Plans**

- 5: Absolutely critical
- 4: Critical
- 3: Important
- 2: Gary
- 1: Not critical

**Target Date(s) for Completion**

- June 2004
- June 2005
- Dec 2005
- March 2005
- June 2004
- Oct 2005

**Status and Notes**

- To be assigned to T-Pipe training
- Will attend T-Pipe training
- On-going replacements are needed
- To be assigned to T-Pipe training
- Will attend T-Pipe training
- On-going replacements are needed

**Documentation**

- 5: Absolutely critical
- 4: Critical
- 3: Important
- 2: Gary
- 1: Not critical

**Target Date(s) for Completion**

- June 2004
- June 2005
- Dec 2005
- March 2005
- June 2004
- Oct 2005

**Status and Notes**

- To be assigned to T-Pipe training
- Will attend T-Pipe training
- On-going replacements are needed
- To be assigned to T-Pipe training
- Will attend T-Pipe training
- On-going replacements are needed

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*TVA’s Approach to Retaining Critical Knowledge in an Aging Workforce*

Fiscal Year 2005

Table: TVA Employees - Sequoyah

<table>
<thead>
<tr>
<th>Indicator</th>
<th>TVA Employees - Sequoyah</th>
<th>June 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFI - Succession Planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMPROVEMENT ACTION PLANS DUE DATE</td>
<td>Conduct attrition survey</td>
<td>Complete</td>
</tr>
<tr>
<td></td>
<td>Complete Review Knowledge Retention updates</td>
<td>Complete</td>
</tr>
<tr>
<td></td>
<td>Succession Planning</td>
<td>18 Positions identified Complete</td>
</tr>
<tr>
<td></td>
<td>24 Candidates identified Complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete Talent Assessment Complete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Develop &amp; Update IDPs Sep-05 Next Succession Planning Meeting 09/22/05</td>
<td></td>
</tr>
</tbody>
</table>

Table: Actual Permanent Employees vs. Approved Forecast

<table>
<thead>
<tr>
<th>Month</th>
<th>Actual Permanent Employees</th>
<th>Approved Forecast</th>
<th>Variance to Approved Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct-Nov-Dec-Jan-Feb-Mar-Apr-May-Jun-Jul-Aug-Sep Total</td>
<td>873 871 866 859 856 856 857 859 873</td>
<td>876 876 876 876 876 876 876 876 876</td>
<td>3 5 10 17 20 20 19 17 3</td>
</tr>
<tr>
<td>Oct-Nov-Dec-Jan-Feb-Mar-Apr-May-Jun-Jul-Aug-Sep Total</td>
<td>876 876 876 876 876 876 876 876 876</td>
<td>829 On-going Classes</td>
<td>6 11 16 19 19 17 18 4 7 8 0</td>
</tr>
</tbody>
</table>

Table: FYTD Replacement %

<table>
<thead>
<tr>
<th>Month</th>
<th>FYTD Replacement %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>70%</td>
</tr>
<tr>
<td>Feb</td>
<td>18%</td>
</tr>
<tr>
<td>Mar</td>
<td>93%</td>
</tr>
<tr>
<td>Apr</td>
<td>72%</td>
</tr>
<tr>
<td>May</td>
<td>45%</td>
</tr>
<tr>
<td>Jun</td>
<td>71%</td>
</tr>
<tr>
<td>Jul</td>
<td>83%</td>
</tr>
<tr>
<td>Aug</td>
<td>89%</td>
</tr>
<tr>
<td>Sep</td>
<td>118%</td>
</tr>
<tr>
<td>Oct</td>
<td>109%</td>
</tr>
<tr>
<td>Nov</td>
<td>107%</td>
</tr>
<tr>
<td>Dec</td>
<td>119%</td>
</tr>
</tbody>
</table>

DEFINITION:

TVAN FY 2005 Performance Plan Staffing Plan

Total TVA employees includes part time employees.

Attrition and replacement counts are for permanent employees only.

Replacement % is the total permanent replacement YTD divided by the total attrition of permanent employees YTD.

SPONSOR: H. K. Fogleman
CONTACT: A. K. Hamala, 2682-C

Examples of KR Options Used

Codification
- Incumbent, in conjunction with the replacement, developed reference library of handbooks, procedures, criteria, and processes for the key knowledge area.

Engineer It Out
- While not purely KR issue, a side benefit/example of this could include redesign/replacement of problematic controllers, which are maintenance intensive and difficult to operate (case where expertise to operate and maintain equipment limited to a few).

Alternative Resources
- In the case of Mechanical Engineer alternate resources were identified in Corporate Office that possessed a portion of this knowledge/expertise.

Education and Training
- Elec Engr Design, w/ expertise in Protective relaying, Switch Gear, breakers, etc. – selected a replacement, then used mentoring, formal training, and OJT to develop the replacement.
- Routinely, utilize subject matter experts as instructors in Technical Training classes to pass on/share critical knowledge items.
Lessons Learned

- Less at-risk knowledge than suspected
- Risk greatest in specialized technical positions and in problem solving strategies
- Range of options to mitigate knowledge loss
- Current procedures may be weak; rely on experienced personnel rather than strong processes and detailed plans

Self Assessment Areas for Improvement
- Program ownership at TVA level
- Closer alignment with Succession Planning and Key Leadership
- Sharing of KR info among organizations
- Inclusion of collateral duties when assessing criticality
- Implementation and follow through/periodic reviews

Questions?
**TVA’s Approach to Retaining Critical Knowledge in an Aging Workforce**

**KNOWLEDGE RETENTION PLAN**

**Directions:**
Knowledge Retention Plans should be developed for knowledge and skills identified as most critical. Plans may include both methods to retain the critical knowledge and skills and actions necessary to mitigate the negative impact of losing the knowledge and skills.

**Options:**
A variety of alternatives can be used to address impending loss of critical knowledge and skill. These include:

<table>
<thead>
<tr>
<th>Staffing Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>New hire or transfer</td>
</tr>
<tr>
<td>Current employee to assume responsibilities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education &amp; Coaching Options</th>
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</thead>
<tbody>
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<tr>
<td>CBT, Video-based, and alternative delivery</td>
</tr>
<tr>
<td>Directed Self-Study</td>
</tr>
<tr>
<td>OJT and Qual Cards</td>
</tr>
<tr>
<td>Targeted Work Assignments</td>
</tr>
<tr>
<td>Coaching, Shadowing and Mentoring</td>
</tr>
<tr>
<td>Apprenticeship Programs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Documentation and Codification Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>New or Revised Procedures</td>
</tr>
<tr>
<td>Checklists, Inventories, etc.</td>
</tr>
<tr>
<td>Performance Support Systems</td>
</tr>
<tr>
<td>Photographic Record</td>
</tr>
<tr>
<td>Concept Maps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Re-engineering Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Improvement</td>
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<tr>
<td>Update Equipment</td>
</tr>
<tr>
<td>“Smart” tools and technology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative or Shared Resources Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agency/site/department expert</td>
</tr>
<tr>
<td>Rotational or “Visiting” Staff</td>
</tr>
<tr>
<td>Multi-skilling, Cross-training, Collateral Duties</td>
</tr>
</tbody>
</table>

**Coordination:**
Some actions included on KR Plans need to be coordinated with other groups in order to be completed. In other instances, a potential knowledge loss issue at one site or within one group may suggest a more widespread threat. To complete the KR Plan or to address broader issues, coordination should occur with such groups as:

- Site training
- Peer Teams
- Process and Methods
- Other Sites
- TVA Corporate
- Key Leadership
- Employee Technical Training
- Succession Planning
- other groups as identified

This coordination should be addressed as part of developing the KR Plan. As needed, senior management addresses coordination or implementation issues which cross major sites or divisions.

<table>
<thead>
<tr>
<th>At-Risk Knowledge or Skill</th>
<th>Actions</th>
<th>Assigned To</th>
<th>Target Date for Completion</th>
<th>Status and Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary is designer of – and expert on --- client database (in Microsoft Access)</td>
<td>- Develop up-to-date documentation of database.</td>
<td>Mary, Mike</td>
<td>July 30</td>
<td>By quarterly review</td>
</tr>
<tr>
<td>- Complete ASP Access training.</td>
<td>Mary, Mike</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Develop documentation on database.</td>
<td>Mary, Mike</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- All - include name activities in PRD.</td>
<td>Mary, Mike</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KNOWLEDGE RETENTION PLAN

Employee: Employee X
Position: Program Manager Elect Install & Cable
Position Risk Factor: 25

Summary and Situation Assessment:
The incumbent has a great deal of critical knowledge and experience related to wiring and cable at all TVAN sites. For example, the incumbent is the only one at TVA performing failure analysis on anything dealing with wire and cable. At present, his analysis can't be checked since he is the only one who knows how to do the analysis.
The incumbent has become known in the industry as an expert dealing with wiring and cable and receives inquiries from other TVA groups (esp. FPG and Hydro) and from outside TVA.
The incumbent has designed, developed and facilitated training at all sites in an effort to establish some site expertise in this area. As a result of this training, there are pockets of knowledge available to handle day-to-day issues. The incumbent maintains more strategic responsibilities (monitoring TVA-wide patterns, identifying emerging issues, following industry developments, etc.) and, lab work, and consulting with the sites. He maintains a number of guides, journals, lists of industry experts and vendor contacts, an internal web site and other resources.
The incumbent also noted that the industry-wide cable/wiring professional network has the same knowledge retention issues surrounding this field as does TVA.  

At-Risk Knowledge or Skill
Expertise on generation-related wiring and cables

Actions
• Recruit, hire and develop an additional wiring and cable expert(s). 1
  Assigned To: Manager Y
  Target Date: Sept. 1, '05
  With approval, position will be advertised internally and externally.

• Develop and implement development plan for an additional wiring and cable specialist.
  Assigned To: Employee X
  Target Date: Sept. 1, 05
  Begin development simultaneous to position advertisement.

• Continue development and maintenance of wiring and cable-related documentation (installation & design guides, lab procedures/processes, etc.)
  Assigned To: Employee X
  Target Date: Ongoing
  Review progress and priorities quarterly.

Note: Since explicit knowledge is not available off the street, then TVA will have to develop in-house. This could take 2 to 3 years. New expert should be a degreed engineer with training and/or experience in electrical, mechanical, chemical, and/or materials/dielectrics.

The incumbent also noted that the industry-wide cable/wiring professional network has the same knowledge retention issues surrounding this field as does TVA.