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Joint ICTP-IAEA School of Nuclear Knowledge Management

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Risk Management of Knowledge Loss in Nuclear Industry Organizations

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Risk Management of Knowledge Loss in Nuclear Industry Organization

Workshop on
Practical Guidance on Risk Management of Knowledge Loss in Nuclear Organizations
September 2008
Trieste, Italy

Presentation by Ed Boyles

Agenda

Risk Management of Knowledge Loss

1. Need to Manage Knowledge
2. IAEA support for NKM
3. Managing the Risk of Knowledge Loss
4. TVA Case Study
5. Lessons Learned

Section 1
Need to Manage Knowledge

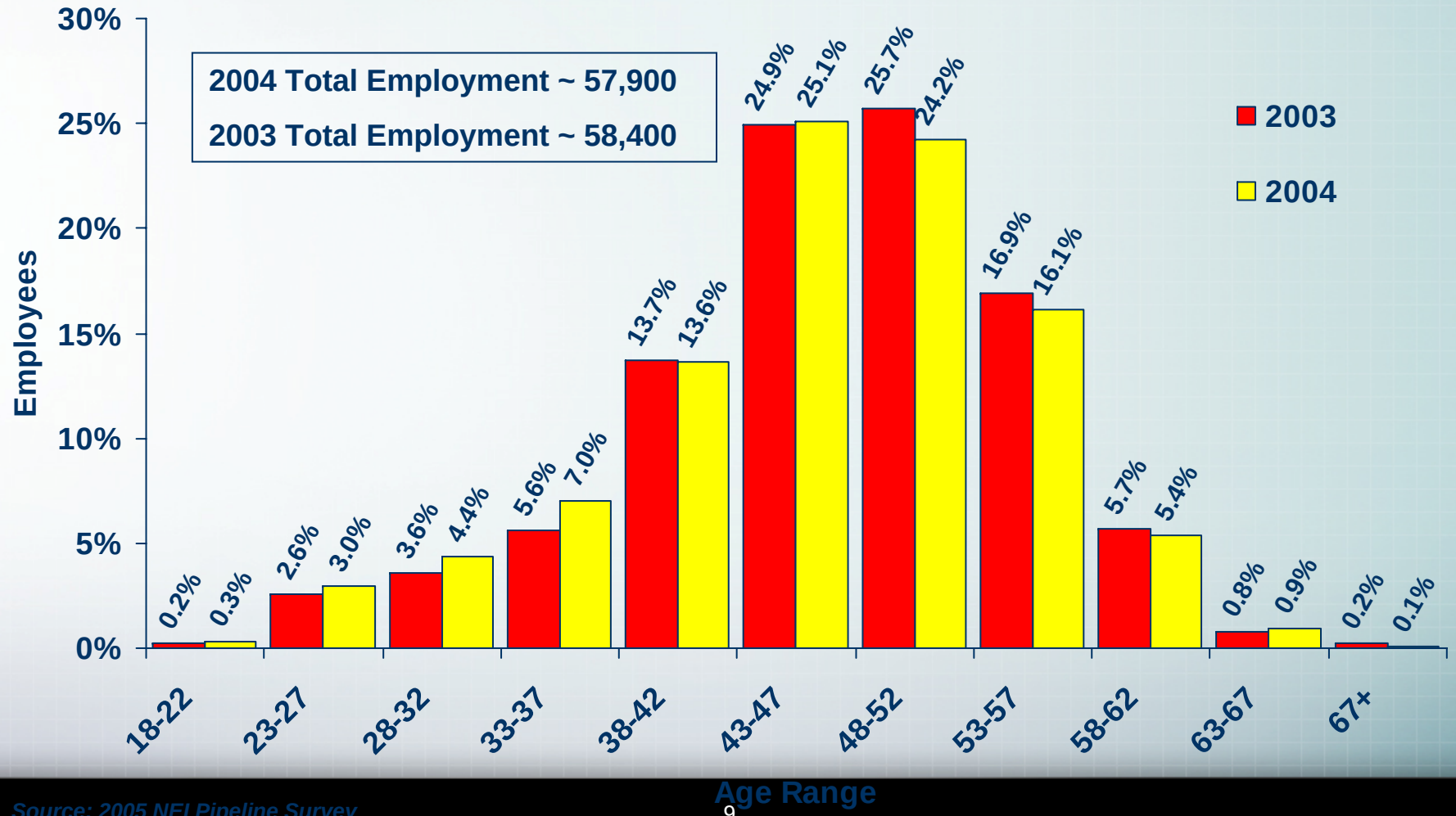
Need to Manage Knowledge

- Average utility worker in the U.S. is 44 years. Average craft worker is 50 (Average U.S. worker is 37)
- By 2010, as many as 60 percent of today's experienced utility workers will retire
- A shrinking labor force means increased competition for talent
- Combined with the renewed interest in nuclear power, significant human resource challenges exist
- As these workers retire and leave the industry, they could take with them critical knowledge and skills
- According to 80 percent of the U.S. industry's HR executives the ageing work force is the number one problem facing the nuclear industry - Less than 50 percent have a plan
- It's not just a U.S. problem but an international one

Need to Manage Knowledge

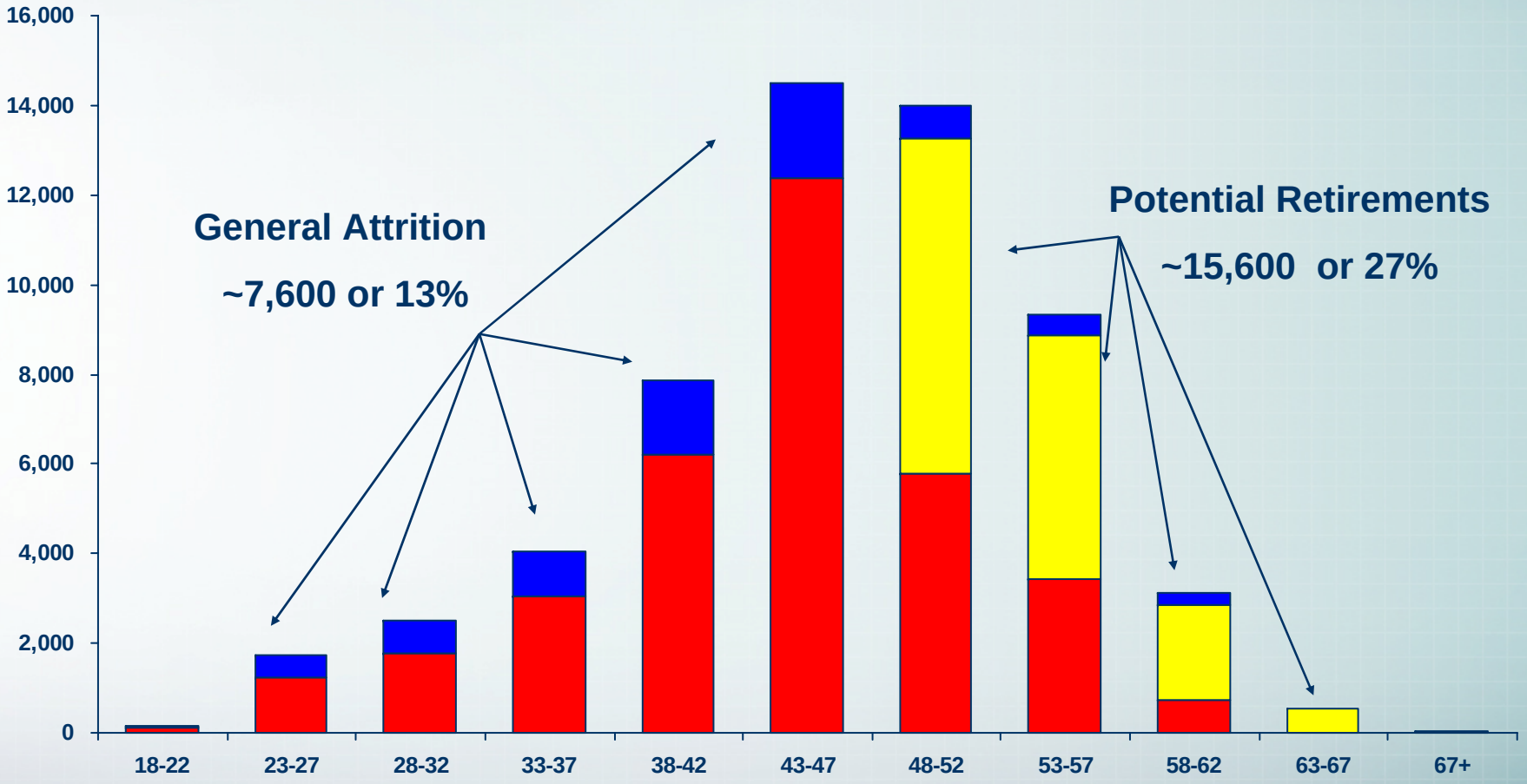
- The nuclear industry work force is aging and nearing retirement in many countries
- Many of these employees have had long and successful careers
- They are the ones who literally designed, built and now operated our plants

Nuclear Industry Employment Distribution by Age



Source: 2005 NEI Pipeline Survey

Nuclear Generation 5-Year Attrition



1. Potential Retirees are defined as employees that will be older than 53 with 25+ years of service, or older than 63 with 20 years of service, or older than 67 within the next five years.

Source: 2005 NEI Pipeline Survey

Section 2
IAEA support for NKM

IAEA support for NKM

- **The IAEA has taken an active leadership role in KM**
- **Raising awareness in Member States:**
  - International Conference on Managing Nuclear Knowledge – September 2004, Saclay, France
  - Second International Conference was held in Vienna in June 2007
- **IAEA has been actively engaged in the direct support of Nuclear Organization in NKM:**
  - Publication of Technical Documents
  - Conducting Regional Workshops on NKM
  - NKM Assist visits

Publication of Tech Docs and Reports

Relevant documents include:

- IAEA-TECDOC-1399 - Ageing Workforce: Transfer of Knowledge To The Next Generation
- IAEA-TECDOC-1510 - Knowledge Management for Nuclear Industry Operating Organizations
- STI/PUB/1248 - Risk Management of Knowledge Loss in Nuclear Industry Organizations
- STI/PUB/1266 - Managing Nuclear Knowledge IAEA Proceedings
- STI/PUB/1235 - Managing Nuclear Knowledge: Strategies and Human Resource Development
- Planning and Execution of Knowledge Management Assist Missions for Nuclear Organisations

Conducting Regional Workshops on NKM

- Managing Nuclear Knowledge - Sevastopol, Ukraine
- Managing Nuclear Knowledge - Karlsruhe, Germany
- Establishing Policies and Strategies to Preserve and Further Enhance Nuclear Knowledge - Obninsk, Russian Federation
- School on Nuclear Knowledge Management - Trieste, Italy

NKM Assist visits

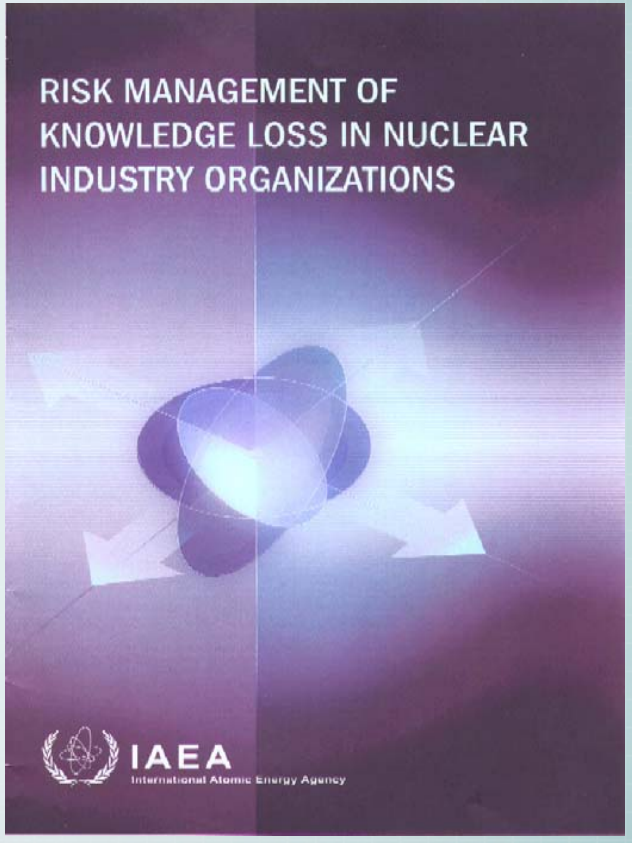
- In 2005 IAEA with assistance from WANO initiated NKM Assistance Visits
- Designed to provide direct support to NPP's
- Utilizes Self-Assessment tool to help NPP management understand the current status of their NKM program
- Involves international experts from several countries

Assist Visit Team Composition

Section 3
Managing the Risk of Knowledge Loss

Section 3 - Retaining Critical Knowledge

- "Risk Management of Knowledge Loss in Nuclear Industry Organizations" – Published July 2006
- Knowledge Loss Risk Assessment Processes and Tools
  - **The Three Step Process**
  - **Employee Self-Assessment**
  - **Institutional Knowledge Loss**



STI/PUB/1248

Knowledge Retention

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 Retention

Step 1 | Step 2 | Step 3

"Knowledge Loss Risk Assessment"

- **"Knowledge Loss Risk Assessment" is designed to identify workers where the potential for knowledge loss is greatest and most imminent**
- **Assessment ratings are based on two factors:**
  - **Time until Retirement (Attrition Risk Factor)**
  - **Position Criticality (Position Risk Factor -assigned by management)**
- **Step provides focus by Identifying workers where actions to mitigate knowledge loss may be needed**

Knowledge Retention

Step 1 | Step 2 | Step 3

Attrition Risk Factor	X	Position Risk Factor	=	Total Risk Factor

Attrition Risk Factor -- Projected retirement dates will be assigned a risk factor as follows:

5 - Within current or next fiscal year

4 - Within 3rd fiscal year

3 - Within 4th fiscal year

2 - Within 5th fiscal year

1 - Within or greater than 6th fiscal year

Knowledge Retention

Step 1 | Step 2 | Step 3

Attrition Risk Factor X **Position Risk Factor** = **Total Risk Factor**

Position Risk Factor -- An estimate of the difficulty or level of effort required to replace the position based upon the following criteria:

5 Mission-critical knowledge/skills. Knowledge undocumented - unique, no duplication - requires 3-5 years of training.

4 Critical knowledge and skills. Some limited duplication exists at other plants/sites and/or some documentation exists - requires 2-4 years of focused training.

3 Important, systematized knowledge and skills. Documentation exists and/or other personnel on-site possess the knowledge/skills.

2 Proceduralized or non-mission critical knowledge and skills Training programs are current and effective and can be completed in less than one year.

1 Common knowledge and skills.

Knowledge Retention

"Knowledge Loss Risk Assessment"

Step 1 Step 2 Step 3

Attrition Risk Factor X Position Risk Factor = Total Risk Factor

Total Risk 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 will 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

Step 1 | Step 2 | Step 3

"Knowledge Loss Risk Assessment"

Attrition Risk Factor	Position Risk Factor 1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Knowledge Retention

Step 1 | Step 2 | Step 3

"Determine Approach to Capture Critical Knowledge"

- Conduct interview to identify potential knowledge loss areas
- Assess consequences of loss using interview results and organization specific critical skills inventories **(What)**
- Prioritize and identify options to retain or mitigate **(So What)**
- Develop and implement action plans **(Now What)**

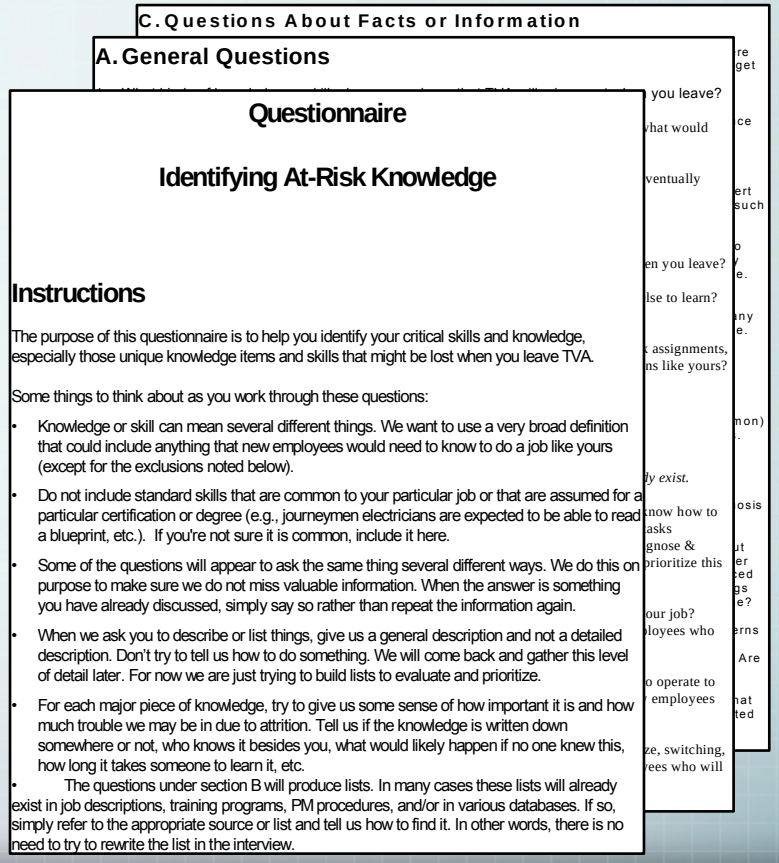
Knowledge Retention

Step 1 | Step 2 | Step 3

Conduct Interview to identify potential Knowledge Loss Areas

Interview Questionnaire

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



C. Questions About Facts or Information

A. General Questions

Questionnaire

Identifying At-Risk Knowledge

Instructions

The purpose of this questionnaire is to help you identify your critical skills and knowledge, especially those unique knowledge items and skills that might be lost when you leave TVA.

Some things to think about as you work through these questions:

- Knowledge or skill can mean several different things. We want to use a very broad definition that could include anything that new employees would need to know to do a job like yours (except for the exclusions noted below).
- Do not include standard skills that are common to your particular job or that are assumed for a particular certification or degree (e.g., journeymen electricians are expected to be able to read a blueprint, etc.). If you're not sure it is common, include it here.
- Some of the questions will appear to ask the same thing several different ways. We do this on purpose to make sure we do not miss valuable information. When the answer is something you have already discussed, simply say so rather than repeat the information again.
- When we ask you to describe or list things, give us a general description and not a detailed description. Don't try to tell us how to do something. We will come back and gather this level of detail later. For now we are just trying to build lists to evaluate and prioritize.
- For each major piece of knowledge, try to give us some sense of how important it is and how much trouble we may be in due to attrition. Tell us if the knowledge is written down somewhere or not, who knows it besides you, what would likely happen if no one knew this, how long it takes someone to learn it, etc.
- The questions under section B will produce lists. In many cases these lists will already exist in job descriptions, training programs, PM procedures, and/or in various databases. If so, simply refer to the appropriate source or list and tell us how to find it. In other words, there is no need to try to rewrite the list in the interview.

Knowledge Retention

Step 1 | Step 2 | Step 3

Identify 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
- OJT and Targeted Work Assignments
- Coaching, Shadowing & Mentoring
- Apprenticeship Programs

Knowledge Retention

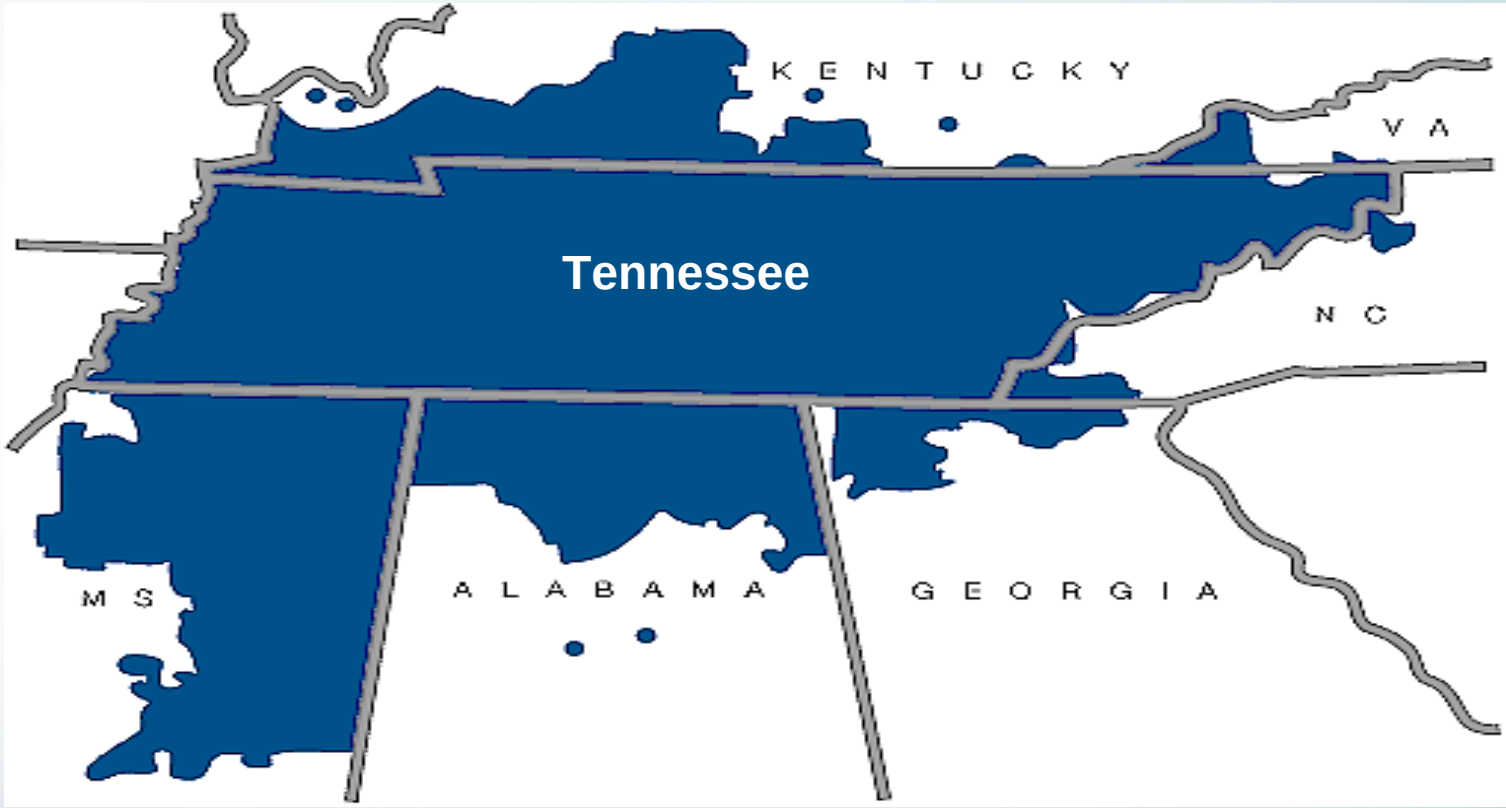
Step 1 | Step 2 | Step 3

Monitor and evaluate knowledge retention plans

- Review updated Projected Attrition Data
- Monitor previous Knowledge Retention Plans
- Identify areas that need to be reassessed
- Coordinate with appropriate organizations and repeat three step process where necessary

Section 4
TVA Case Study
An Integrated Approach

Who is TVA?



The Tennessee Valley Authority

- America's largest public power producer
- 8.5 million customers; 7 states
- $7.7 Billion in Revenue
- Wholesale power through a network of 158 municipal and cooperative power distributors
- 12,600 Employees
- Capacity – 32,000 MWe
  - 3 nuclear plants
  - 11 coal-fired plants
  - 29 hydroelectric dams
  - 1 pump storage facility

Nuclear Power Group

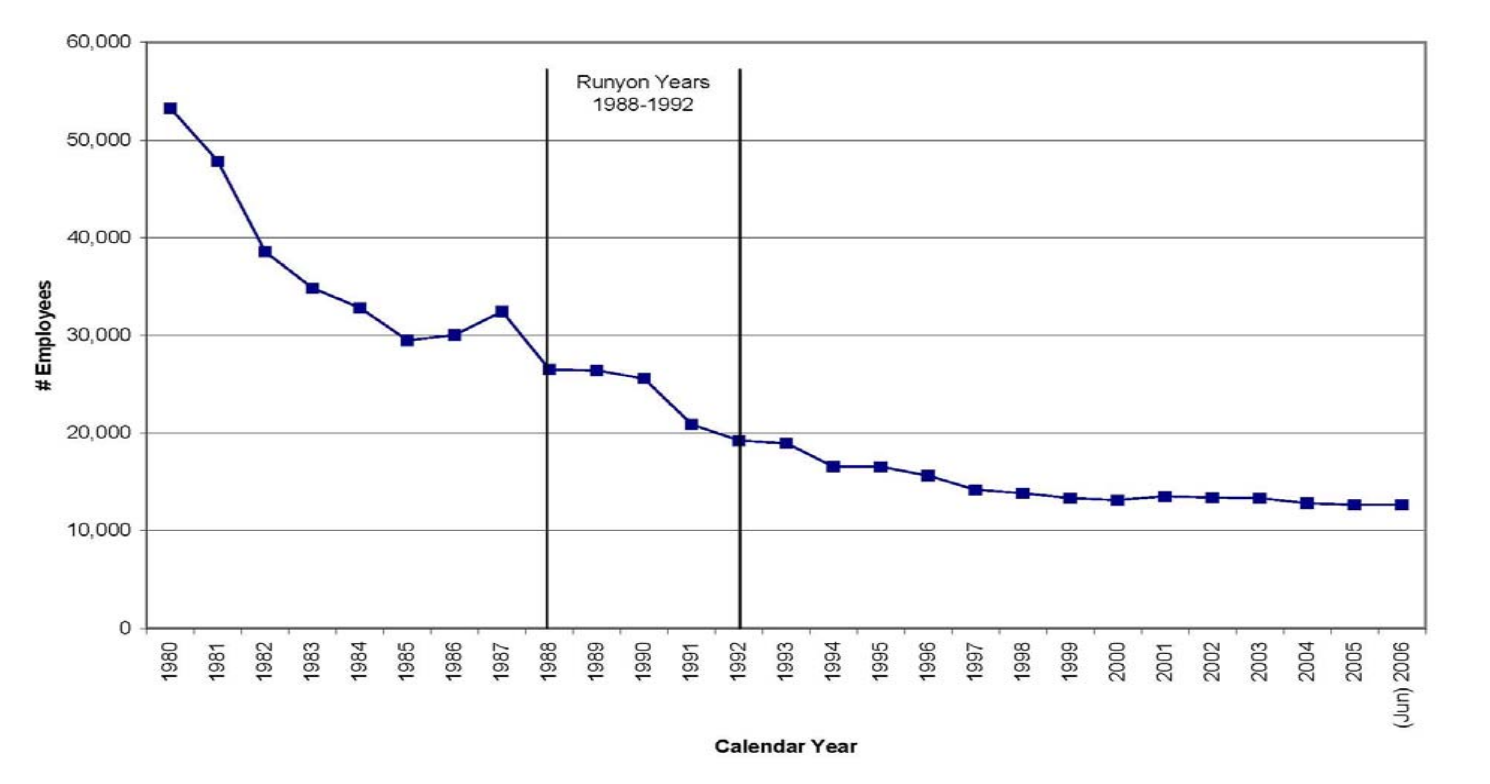
- 6 units at three locations plus central office in Chattanooga - About 2,8000 permanent employees
  - Browns Ferry
  - Sequoyah
  - Watts Bar
  - Chattanooga Corp. Office
- Capacity = 6,800 MWe
- About 28% of TVA's power supply
- In May 2007 Browns Ferry Unit 1 was restarted after 22 year shutdown
- In January 2008 work began to complete Watts Bar Unit 2

TVA Corp Office – Chattanooga, Tennessee

The TVA Attrition Challenge

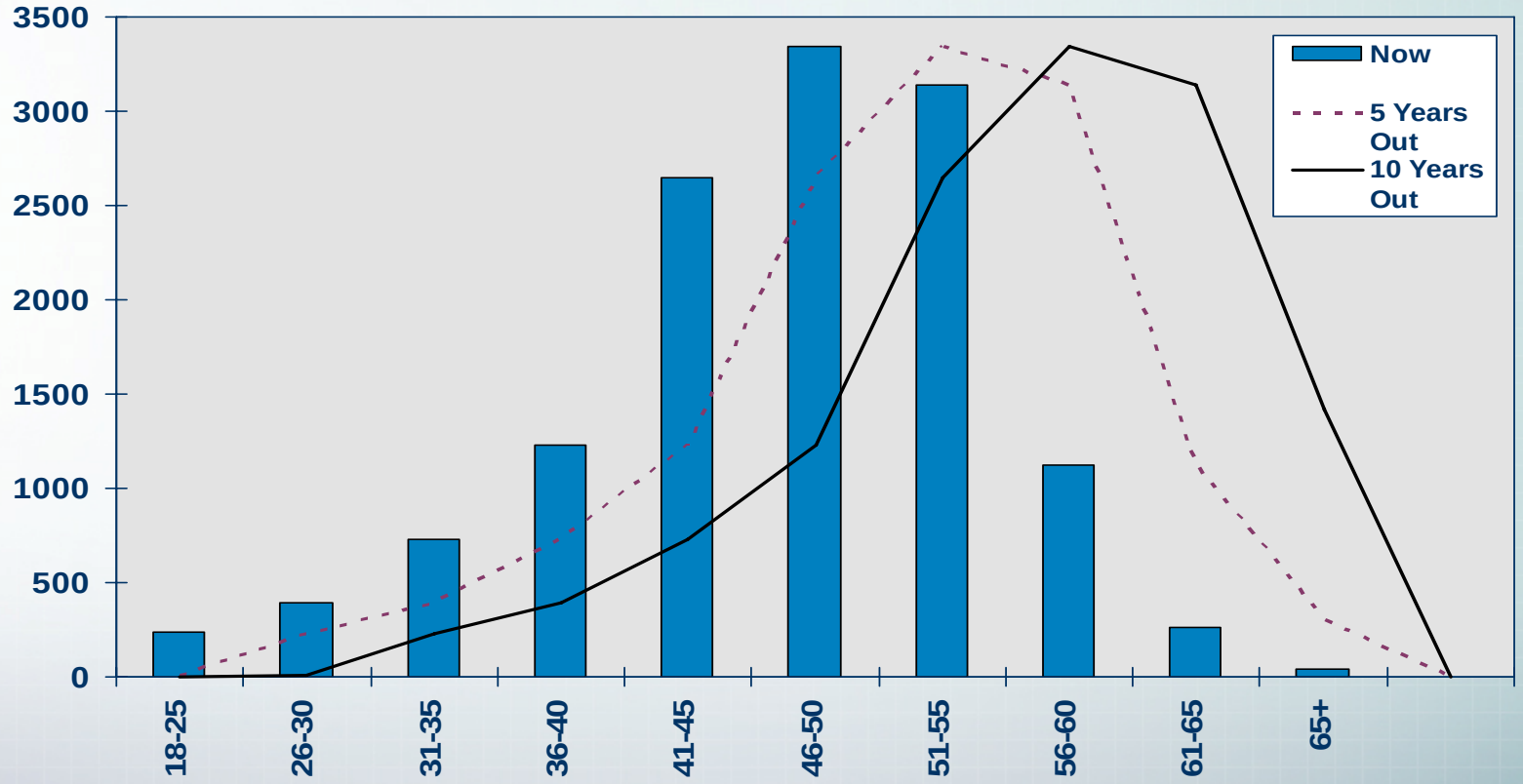
Historical Perspective 1980 – 2006

- From 53,000 to Less Than 12,600 Employees
- Nuclear Power Group from 13,900 to Less Than 2,800



The TVA Attrition Challenge

An Aging Work Force Nearing Retirement
Employee Age Distribution - 1998



The Attrition Challenge

- Significant downsizing over 15+ years
- Various retirement incentives to aid downsizing
- Very limited entry level recruiting
- Average age – 48; Average retirement age - 56
- Approximately 1/3 of work force was eligible to retire within next 5 years
- ***The possibility of losing "critical knowledge" was great***
- ***The three step process was implemented in Nuclear Power Group in 2000 and in other groups (Fossil, Hydro, etc.) by 2003***

RESULTS

Of Six Years Implementation

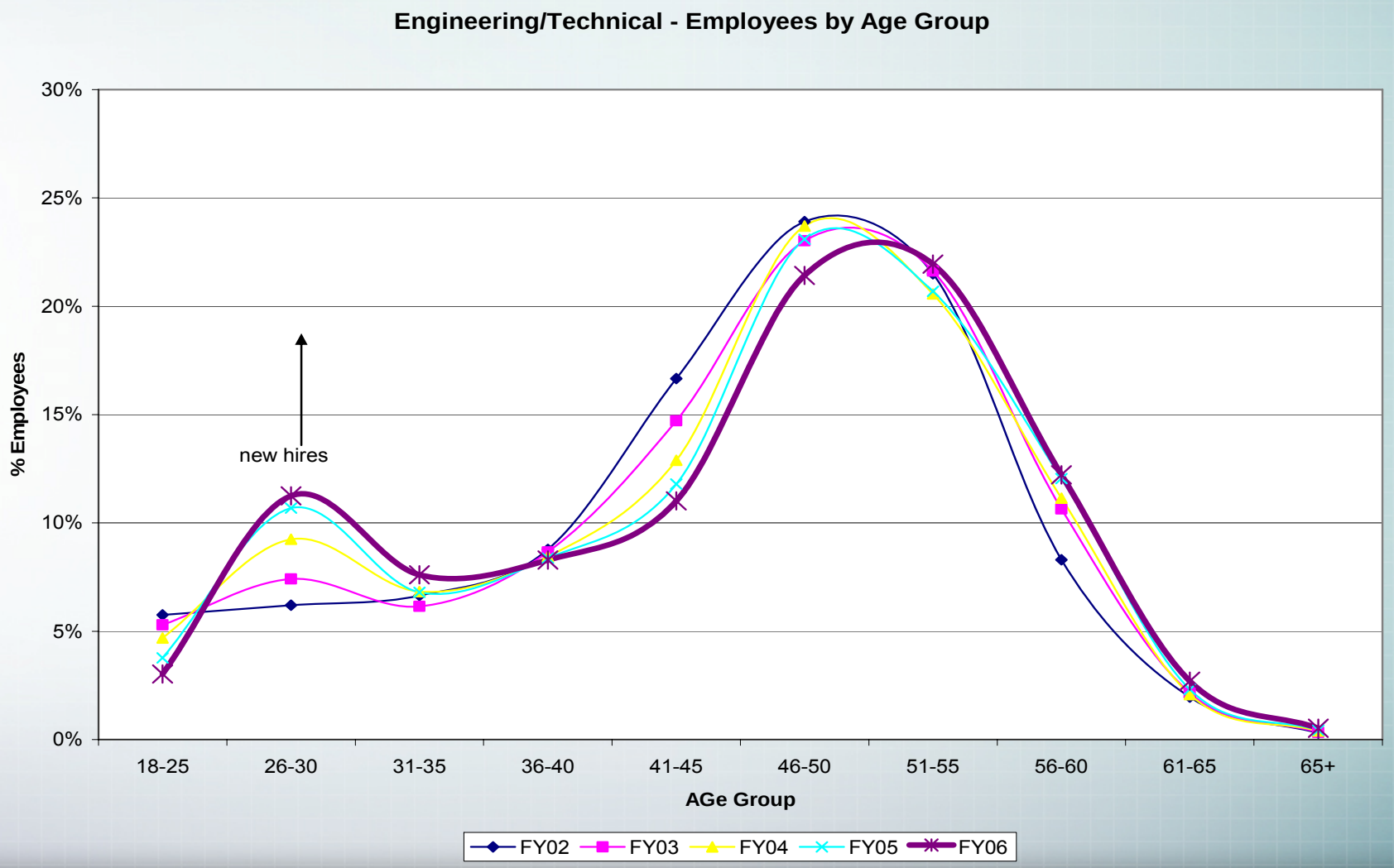
Critical Knowledge Risk – Total Risk Factor
2007 Status Update

- Only 0.1% of greatest urgency (score above 20)
- 1.6% (193 positions) with scores about 15
- 0.4% (48 positions) with position risk of 5 (unique knowledge)

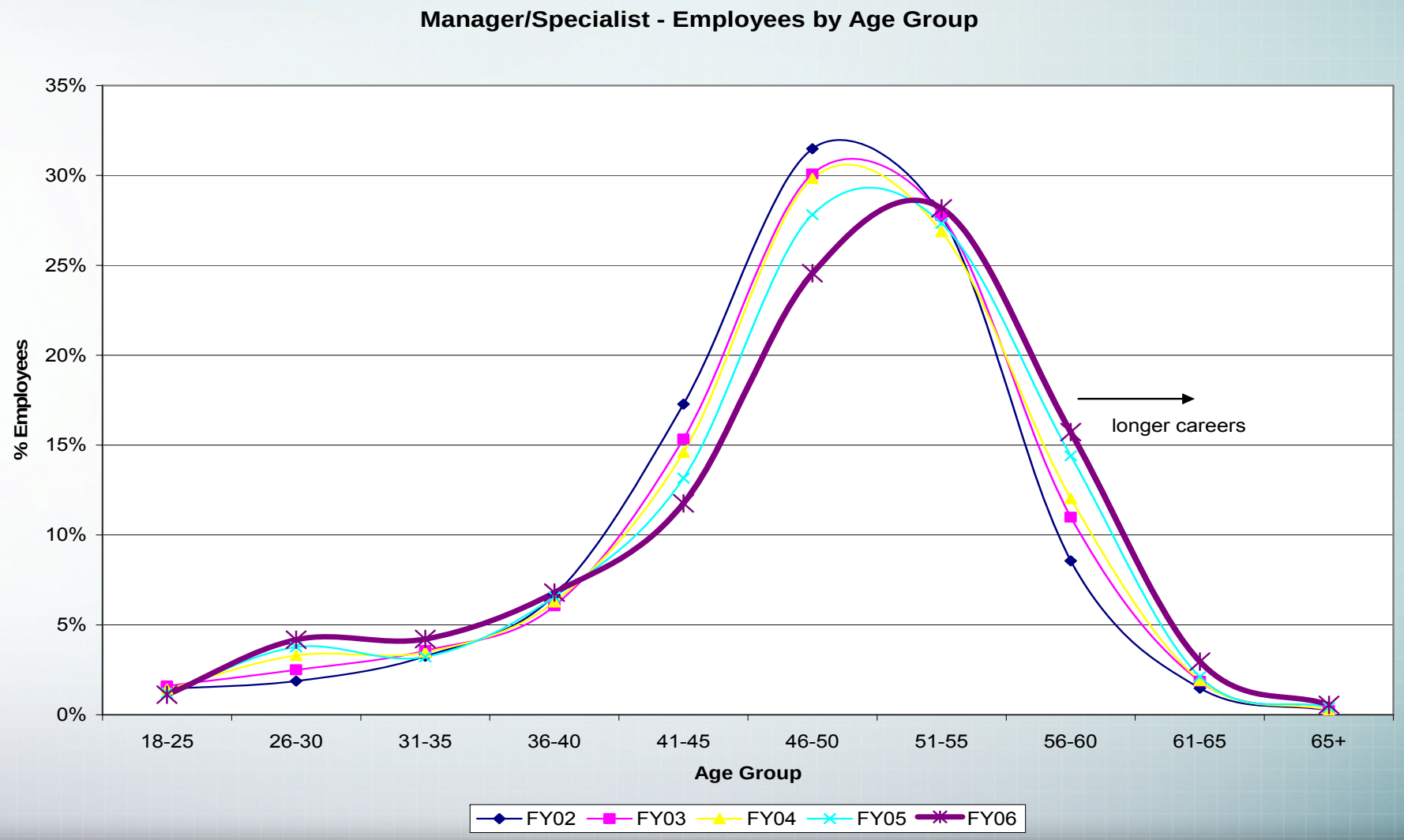
Attrition Risk Factor	Position Risk Factor 1	2	3	4	5
5	29	65	141	3	1
4	75	197	468	34	8
3	81	210	491	41	6
2	69	180	473	27	3
1	1,175	2,724	5,059	226	30

Staffing Risk

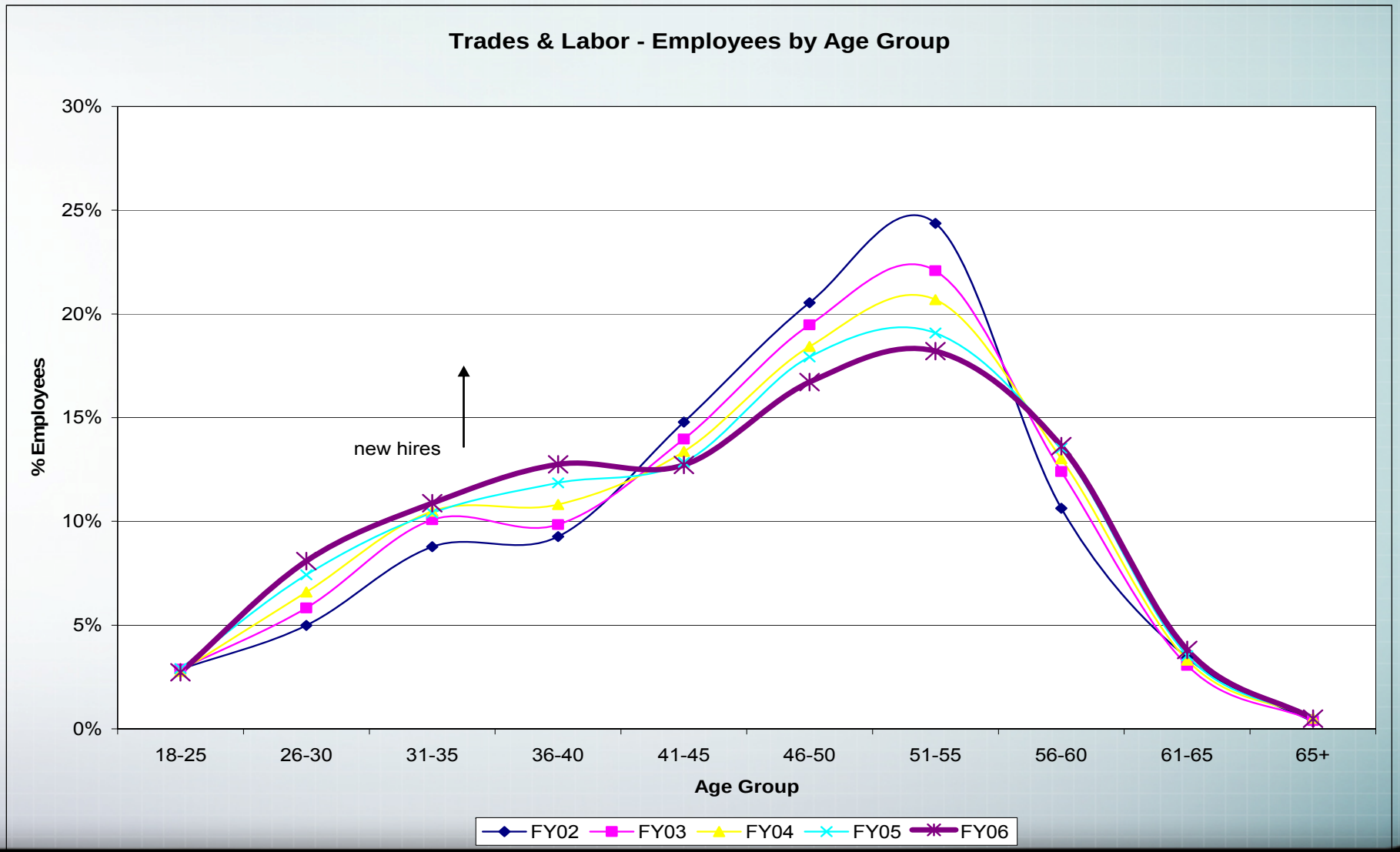
Staffing Risk



Staffing Risk



Staffing Risk



Section 5

Lessons Learned

Lessons Learned

- Less at-risk knowledge than suspected
- Risk greatest in specialized technical positions and in problem solving strategies
- Wider range of options to mitigate knowledge loss than is typically considered
- Process and procedures are sometimes weak – Creates an over-reliance on “tribal knowledge” and individual expertise
- Pockets, or Functional Areas, of risk may exist
- Line Managers must own the solutions

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