SAND2012-7031P

International Atomic Energy Agency

# Maintenance and Performance Testing of PPS

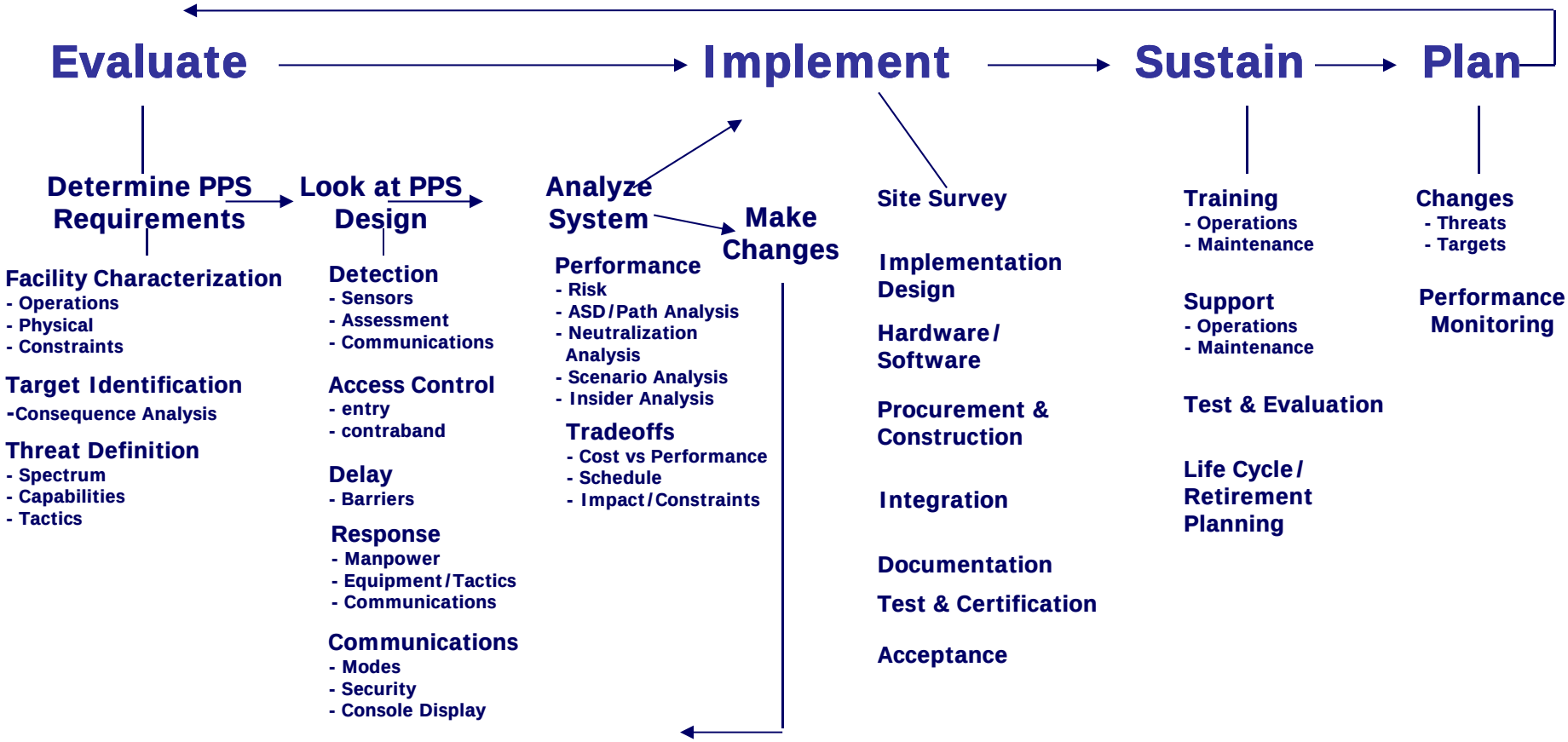
Regional Training Course on Security of Research Reactors

Jakarta, Indonesia, 8-12 October 2012

# Learning Objectives

- Identify where maintenance and performance testing occurs within the PPS life cycle
- Identify IAEA guidance on maintenance and performance testing for a PPS
- Identify what is maintenance for a PPS
- Identify types of maintenance activities
- Identify the purpose and importance of performance testing
- Differentiate between different kinds of performance testing
- Outline the testing process

# PPS Life Cycle Process



# IAEA Guidance on Maintenance

- Competent authorities are responsible for putting in place sustainment of detection and response measures including instrument maintenance and a maintenance program for response equipment.
- Competent authorities ensure that an instrument deployment plan includes such measures as: initial installation, calibration, acceptance testing, setting up maintenance procedure, training and qualification of technical support staff
- Operators should prepare security plans that address maintenance of PPS and security procedures to be followed before and after maintenance
- Operators should develop a means and procedures for evaluations, including performance testing and maintenance of PPS.
- Operators should establish a sustainability program that includes equipment updating, maintenance, repair and calibration.

# Maintenance

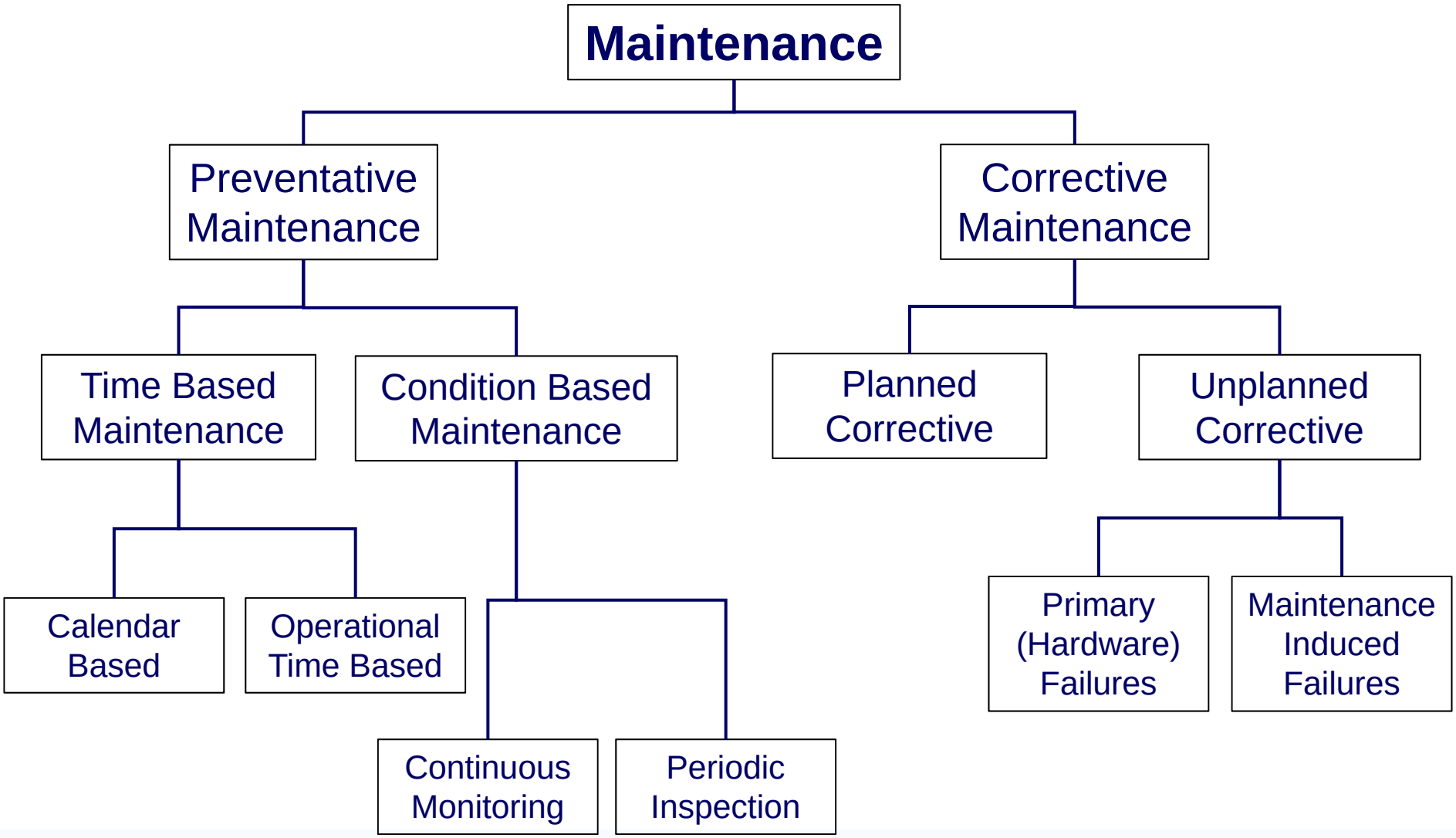
- **Maintenance:** Actions taken to keep some item/component/system in proper condition to perform its mission.
  - Preventative maintenance
  - Corrective maintenance
  - Reliability centered maintenance

- **Preventative Maintenance:** Periodic component inspection, test, service, calibration, repair or replacement activities that are intended to preserve the inherent reliability of components.

- **Corrective Maintenance:** Repair and restoration of components or components that have failed or are malfunctioning and are not performing their intended mission.

- **Reliability Centered Maintenance:** Systematic evaluation approach for developing or optimizing a maintenance program.

# Example Maintenance Structure



# Maintenance

- **Technical support – hardware, software**
  - Hardware/software support specialist, maintenance experts
  - Maintenance, testing and calibration
  - Procedures for determining problems, failures, deficiencies
- **Work planning and control system**
  - Initiates and tracks maintenance activities
  - Identifies tools, equipment and other resources needed
- **Data analysis tools and procedures**
  - Measurable attributes about system health
  - Metrics - False and nuisance alarm rates, mean time between failures …
  - Tools that can be used to record and analyze, performance, trends

# Maintenance

- **Configuration management system for PPS**
  - Changes in the PPS can have an adverse effect on system performance
- **Master equipment list (MEL)**
  - PPS related hardware, software; activities related to equipment
  - Supports graded approach to maintenance management
- **Spare parts**
  - Consider failure data, cost, shelf life, storage requirements …
- **Tools and equipment to perform maintenance functions**
  - Maintenance people need tool sets, vehicles, communications…
- **Other – Warranties, Service Agreements**

# IAEA Guidance on Performance Testing

- Competent authority should ensure evaluation based on performance testing
- Evaluations include exercises to test the integrated system, including training and readiness of guards and response forces
- Operator should develop and implement means and procedures for evaluations, including performance testing and maintenance of the PPS
- Operators, Shippers and Carriers should establish sustainability programs that include performance testing and operational monitoring
- Performance testing a PPS should include appropriate exercises to evaluate guards and response force effectiveness and timely response (Cat I/II, high radiological consequences)
- Performance testing of a PPS should be conducted annually (Cat I)

# Performance Testing

- ***Performance test:*** Testing of the physical protection measures and the PPS to determine whether or not they are implemented as designed; adequate for proposed natural, industrial and threat environments; and in compliance with established performance requirements.

- **Performance tests are a means to:**
  - Establish or confirm a performance level of a PPS element
  - Provide comprehensive assurance of performance on a required basis
  - Determine element's baseline performance for system design
  - Test PPS elements over their planned range of operation

- **Performance testing results**
  - Identify if element(s) tested performed adequately
  - Identify weaknesses or substandard performance

# Performance Testing

## Purpose and Objectives

- **Purpose of performance testing is to evaluate the performance of**
  - People,
  - Procedures, and/or
  - Equipment, technology, hardware

- **Objectives of performance testing:**
  - Validate vulnerability analysis input data, assumptions, activities, results, and conclusions
  - Demonstrate protection capabilities
  - Ensure that the performance of protection elements provide adequate protection and acceptable risk

# Performance Testing

## Types of Testing

- **Example types of tests that can measure effectiveness**
  - Operability and functional tests
  - Sub-system performance tests
  - Whole system performance tests

# Performance Testing

## Operability and Functional Tests

- **Simple measure of operability – is it working?**
- **Simple measure of functionality – does it function as intended?**
  - Performed on a frequent basis
  - Looks for significant malfunctions or outages
  - If the test fails, call maintenance and possibly take compensatory measures
- **Examples (each shift):**
  - Metal detectors
  - X-ray machines
  - Walk test a certain number of perimeter sectors to verify alarms are generated

# Performance Testing

## Sub-system Performance Tests

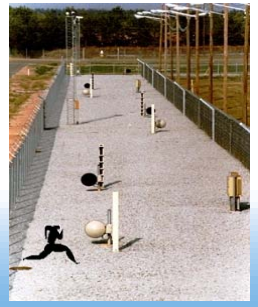
- **Sub-system Performance Testing focuses on the performance and effectiveness of either individual components or parts of the overall PPS**
  - Perimeter detection & delay, entry control, alarm communications, response force deployment tactics
- **Conducted to**
  - Evaluate the skills, capability, or knowledge of personnel
  - Test operations, procedures, or policy requirements
- **Sub-system tests should be conducted realistically—they may be either scheduled or unannounced**
  - Examples
    - Protective force response to an alarm
    - Technology / equipment and procedures at personnel and vehicle entry control portals

# Performance Testing

## Whole System Performance Tests

- **Whole System Performance Tests are conducted to evaluate the overall effectiveness of all elements of an entire system**
- **OR large portions of an entire system**
  - **Example 1: Force-on-force security exercise tests the overall effectiveness of all elements involved in a response to a site-specific threat and adversary capabilities**

  - **Example 2: Used to determine how effectively individual elements of a perimeter perform together to form an entire system**



# Performance Testing

## When to Conduct Performance Tests

- **On new and proposed PPS equipment to determine effectiveness and limitations**
- **On PPS equipment after initial installation and after maintenance to verify component performance**
- **On new and existing security procedures – determine whether**
  - Personnel understand and follow the procedures
  - Personnel and equipment interact effectively
- **Ensure that protection elements are performing as designed and provide the required protection level**

# Performance Testing

## Performance Testing Process

- Plan the performance test
- Define test purpose, objectives, and standards
- Create a test plan
- Identify protection elements to be tested and test locations
- Identify threats (capabilities) and develop scenarios
- Define testing methodology and evaluation criteria
- Define test controls
- Identify resource requirements
- Coordinate the tests and obtain approvals
- Identify compensatory measures
- Collect data; analyze, document, performance metrics (confidence levels) and critique test

# Performance Testing

## Response Force (RF) Performance Testing

- **Response components are tested individually to establish performance**
  - People, weapons, vehicles, equipment, etc.
- **Subsystem performance testing**
  - Different types of tests used to test performance of RF functions
  - Testing subsystems of whole system (e.g., Alarm Station)
- **Whole system performance testing**
  - Testing of whole system (e.g., force-on-force)
  - Two performance measure criteria are evaluated
    - Interruption
    - Neutralization

# Conclusion

- **Maintenance and Performance Testing are considered during several phases of the PPS life cycle and involve a number of activities**
- **Maintenance can be preventative, corrective or reliability centered**
- **Many types of tests can measure effectiveness**
  - Operability and functional tests
  - Component, sub-system, and
  - Whole system performance test
- **Performance testing should include:**
  - Evaluation of people, procedures, equipment/hardware/technology
  - Test against the defined threat (insider and outsider)
- **The results of performance testing provide a basis for the calculation of protection system effectiveness**
  - During design process
  - Throughout life of the system