

# **WELCOME TO THE LECTURE ON MAINTENANCE**

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# **MAINTENANCE PROGRAMME**

## **ELEMENTS**

- ORGANIZATION AND ADMINISTRATION
- STAFFING AND TRAINING
- FACILITIES TOOLS AND EQUIPMENT
- BALANCED USE OF RESOURCES
- MAINTENANCE PROCEDURES
- SELF ASSESSMENT, SELF CHECKING,  
INDEPENDENT VERIFICATION
- SPARE PARTS

# **MAINTENANCE PROGRAMME**

## **ELEMENTS (cont)**

- TESTING AND VERIFICATION
- HISTORY
- IN SERVICE INSPECTION
- ROOT CAUSE ANALYSIS
- RADIATION PROTECTION
- CONFIGURATION CONTROL

## **MAINTENANCE GENERAL**

- PREVENTS DEGRADATION
- PREVENTS FAILURES
- HIGH STANDARDS REQUIRED
- NEEDS CO-OPERATION
- TRAINING
- LEADERSHIP

## **ORGANIZATION AND ADMINISTRATION**

- GOALS AND OBJECTIVES
- PERFORMANCE INDICATORS
- MANAGERIAL INVOLVEMENT
- DEFENSE IN DEPTH EMPHASIZED
- INTERFACES DEFINED

# **MAINTENANCE PERFORMANCE**

## **TYPICAL PERFORMANCE INDICATORS**

- BACKLOG OF MAINTENANCE WORK
- % OF EFFORT ON BREAKDOWN MAINTENANCE
- PREVENTIVE MAINTENANCE WORK DEFERRED
- CONTROL ROOM INSTRUMENTS OUT OF SERVICE
- REPEAT WORK
- ACCIDENT RATE
- WRENCH TIME
- PRODUCTION LOSS OR SAFETY SYSTEM UNAVAILABILITY DUE TO EQUIPMENT FAILURE

# **MAINTENANCE/OPERATION QUALITY**

## **RESULTS**

- REDUCE REWORK
- REMOVE OBSTACLES
- REDUCTION PM/CALL-UP BACKLOG
- REDUCTION IN EVENTS WHERE OPERATION/MAINTENANCE QUALITY INVOLVED
- QUALITY "BUILT IN" DURING JOB BY SKILLED AND PROFICIENT PEOPLE BECAUSE IT'S IMPORTANT TO DO JOB RIGHT THE FIRST TIME
- TAKE THE TIME TO DO THE JOB SAFELY AND TO QUALITY STANDARDS

# **MAINTENANCE/OPERATION QUALITY**

## **MAJOR THRUSTS**

- SELF CHECKING
  - SUPERVISORY ASSESSMENT
  - SELF ASSESSMENT
- }
- CRAFTSMANSHIP  
AS ANSWER TO  
VERIFICATION
- 
- AVAILABILITY OF TOOLS AND MATERIAL
  - WORK PRACTICE COMPLIANCE TO  
DEVELOPED QUALITY  
STANDARDS/EXPECTATIONS



# **MAINTENANCE/OPERATION QUALITY**

## **MEASURES OF SUCCESS**

- **% REWORK**
- **SERs**
- **REDUCTION CALL UP BACKLOG**
- **ACTUAL DURATION VS ESTIMATED JOB DURATION**

## **ROLE OF SUPERVISION**

- EXERCISE JUDGEMENT ABOUT
  - HUMAN AND EQUIPMENT CAPABILITIES
  - COACHING - INSTRUCTION REQUIRED
  - EXECUTION OF WORK
- ASSIGN AND CONTROL WORK
- ENSURE APPROPRIATE QUALITY
  - DEFINE PERFORMANCE STANDARD (EXPECTATION)
  - OBSERVATION OF WORK
  - VERIFICATION

# SUPERVISION

## JUDGEMENT

EFFECT OF  
SUCCESS  
FAILURE OR  
ERROR ON:



## CONTROL

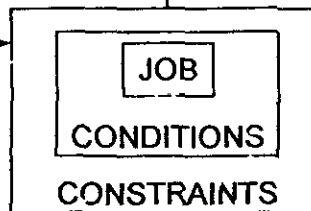
- RELIABILITY
- CITIZENSHIP
- PRODUCT COST
- EMPLOYEE SAFETY
- CONSERVATION

## QUALITY

## RESULT

### MANPOWER

- EXPERIENCE
- TRAINING
- WORK RECORD
- SAFETY RECORD
- BEHAVIOURAL RECORD



### TOOLS AND MATERIAL

- TOOL BOX
- TOOL CRIB
- STORES, MATERIAL
- SPECIAL TOOLS AND MATERIAL
- SAFETY EQUIPMENT

### APPROVED PROCEDURE

- WRITTEN PROCEDURE
- WRITTEN WORK PLAN
- VERBALLY AGREED PROCEDURE
- BASIC WORK

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## **STAFFING AND TRAINING**

- SUFFICIENT TRAINED STAFF
- REQUIRED SKILLS
- MOCK-UP TRAINING
- SELF CHECKING SKILLS
- MANAGEMENT INVOLVEMENT

## **FACILITIES TOOLS AND EQUIPMENT**

### **SIZE AND ARRANGEMENT**

- **SEGRETATION**
- **TOOLS**
- **RIGGING EQUIPMENT**
- **DECONTAMINATION FACILITIES**
- **MEASURE AND TEST EQUIPMENT**
- **HAZARDOUS EQUIPMENT**
- **LIFTING ROUTES**

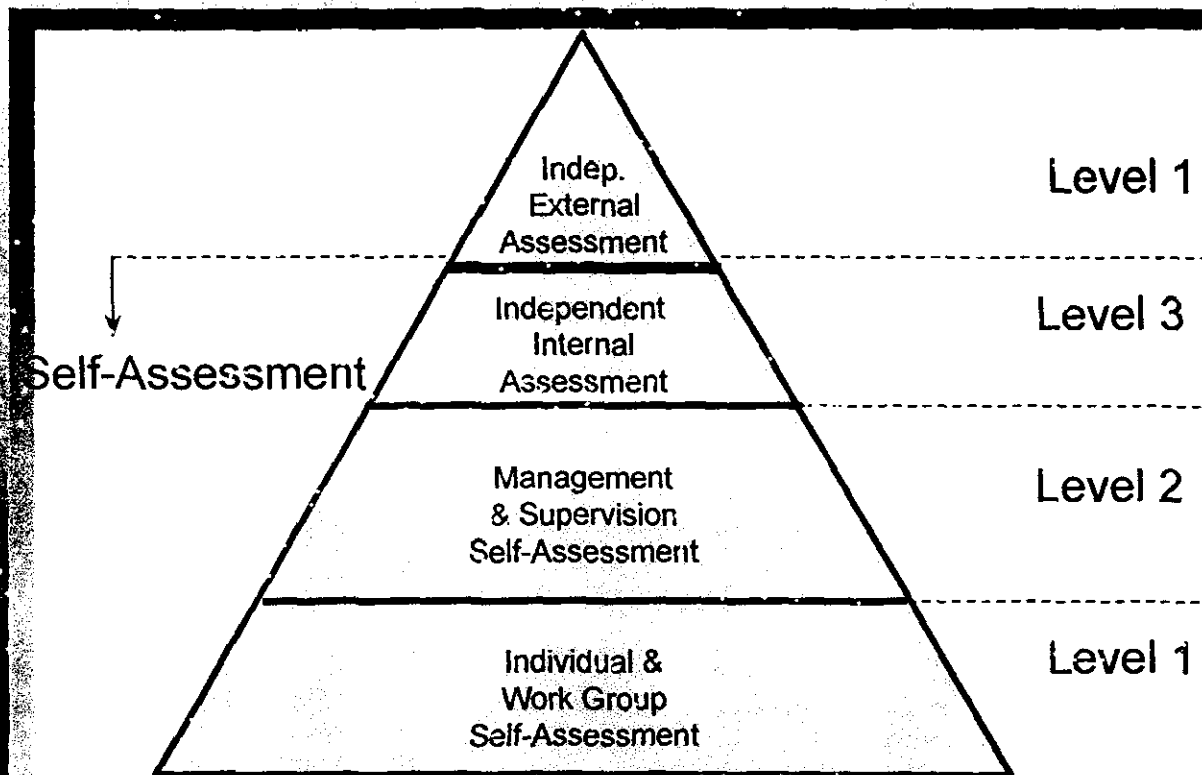
## **MAINTENANCE PROCEDURES**

- POLICY NEEDED
- PREPARATION CORRECT
- USAGE
- SUFFICIENT DETAIL
- TEMPORARY CHANGES
- FEEDBACK MECHANISM
- HUMAN FACTORS

## **ASSESSMENT CHECKING VERIFICATION**

- **PROGRAMME REQUIRED**
- **SELF-ASSESSMENT**
- **INDEPENDENT VERIFICATION**
- **SELF CHECKING**

# SELF ASSESSEMENT





## **INDEPENDENT VERIFICATION**

- **USED WHEN PLANT UPSET CAN BE CAUSED BY THE MISTAKE OF ONE INDIVIDUAL**
- **COMPLIMENTARY TO SELF CHECKING**
- **SIGNIFICANTLY REDUCES THE POSSIBILITY OF ERROR**
- **VERIFICATION MUST TAKE PLACE BEFORE THE ACTIVITY IS CARRIED OUT**
- **HELPS PREVENT ERRORS DUE TO:**
  - **WRONG UNIT**
  - **WRONG SYSTEM**
  - **WRONG COMPONENT**
  - **WRONG ISOLATION**
  - **WRONG PROCEDURE**

## **SELF CHECKING**

**STOP**

**THINK**

**ACT**

**REVIEW**

## **SPARE PARTS**

- **SUPPORT EFFECTIVE MAINTENANCE**
- **CORRECT STANDARDS**
- **STORAGE REQUIREMENTS**
- **HAZARDOUS MATERIAL**

## **OTHER ELEMENTS**

- TESTING AND VERIFICATION
- MAINTENANCE HISTORY
- IN-SERVICE INSPECTION
- ROOT CAUSE ANALYSIS
- RADIATION PROTECTION
- CONFIGURATION CONTROL

# **MAINTENANCE PROGRAMMES**

## **PREVENTIVE**

**CAN BE DEFINED AS " ACTIONS TAKEN ON A ROUTINE BASIS TO PREVENT EQUIPMENT BREAKDOWN'**

**ELEMENTS OF PREVENTIVE MAINTENANCE ARE:**

- **PREDICTIVE MAINTENANCE**
  - **THIS CONSISTS OF MEASURING OIL SAMPLES, VIBRATION & TEMPERATURE ETC. TO PREDICT EQUIPMENT FAILURE**
- **PERIODIC MAINTENANCE**
  - **ACTION TAKEN ON A ROUTINE BASIS TO PREVENT EQUIPMENT FAILURE**

# **MAINTENANCE PROGRAMMES**

## **PREVENTIVE MAINTENANCE**

**ENABLES MAINTENANCE TO BE PRE-PLANNED  
BASED ON:**

- **PERIODIC MAINTENANCE FINDINGS**
- **PREDICTIVE MAINTENANCE FINDINGS**
- **EXPERIENCE**
- **SUPPLIER'S RECOMMENDATIONS**

## **BREAKDOWN MAINTENANCE**

### **CORRECTIVE**

**CAN BE DEFINED AS 'REPAIR OR REPLACEMENT OF EQUIPMENT THAT HAS FAILED IN SERVICE'**

- **NOT POSSIBLE TO ELIMINATE IT**
- **SHOULD BE MINIMIZED BY EFFECTIVE MAINTENANCE**
- **MORE DIFFICULT TO PREPLAN THIS MAINTENANCE**

## **WORK CONTROL**

- **CROSS FUNCTIONAL**
- **REQUIRES CO-OPERATION**
- **CRUCIAL TO SUCCESSFUL  
MAINTENANCE**



# **MAINTENANCE PLANNING**

- AVOID CRISIS MENTALITY
- BALANCE SHORT TERM AND LONG TERM NEEDS, SUCH AS:
  - BREAKDOWN MAINTENANCE BACKLOG
  - PREVENTIVE MAINTENANCE CALL UPS
  - MATERIAL CONDITION
  - COMPONENT REFURBISHING
  - TOOL MAINTENANCE
  - TRAINING
  - TEST EQUIPMENT CALIBRATION

# **MAINTENANCE PLANNING IN CANADA**

## **UTILIZES INTEGRATED OPERATIONAL PLANNING**

- **INTEGRATES PREVENTIVE AND BREAKDOWN MAINTENANCE**
- **INTEGRATES OPERATIONS AND MAINTENANCE ACTIVITIES**
- **ENSURES ALL THE PLANT OBTAINS THE APPROPRIATE MAINTENANCE ATTENTION**
- **REQUIRES UP FRONT WORK TO SET UP THE PROCESS**

## **OUTAGE**

**GOOD OUTAGE PLANNING  
WILL NOT GUARANTEE  
A SUCCESSFUL OUTAGE**

**POOR OUTAGE PLANNING  
WILL GUARANTEE  
AN UNSUCCESSFUL OUTAGE**

# **OUTAGE OBJECTIVES**

## **EXAMPLES**

### **OUTAGE DURATION**

- SCHEDULE ADHERENCE
- EFFECTIVENESS OF OUTAGE PREPARATION
- COLLECTIVE AND INDIVIDUAL RADIATION EXPOSURE
- % COMPLETION OF PLANNED WORK
- EMERGING WORK
- ACCIDENT RATE
- RE-WORK
- BUDGET
- OPERATING ERRORS
- SOLID RADIOACTIVE WASTE GENERATED

# **AGEING**

## **INFLUENCED BY**

- **CHEMICAL OR PHYSICAL PROCESSES**
- **IN-SERVICE WEAR**
- **IMPROPER INSTALLATION**
- **IMPROPER MAINTENANCE**

## **MUST CONSIDER**

- **DEGRADATION PROCESSES**
- **SUSCEPTIBLE COMPONENTS**
- **ADEQUATE TESTING**
- **APPROPRIATE RECORDS**

## **CONDUCT OF MAINTENANCE**

- **SAFE AND EFFICIENT**
- **PROFESSIONAL AND COMPETENT**
- **RESPONSIVE TO DEFICIENCIES**
- **INCORPORATE ALL PROGRAMME ELEMENTS**

## **MATERIAL CONDITION**

- MAINTAINS SAFE RELIABLE AND EFFICIENT OPERATION
- CONFIRMED BY FREQUENT EFFECTIVE MANAGEMENT TOURS
- RELIES ON:
  - EFFECTIVE MAINTENANCE PROGRAMMES
  - EFFECTIVE WORK CONTROL
  - ABILITY TO RECOGNISE DEFECTS
  - LOW TOLERANCE FOR DEFECTS