

WELCOME TO THE LECTURE ON MAINTENANCE

R.B. TAYLOR

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 - CONTROL - QUALITY

EFFECT OF
SUCCESS
FAILURE OR
ERROR ON:

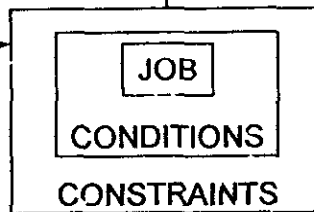


- RELIABILITY
- CITIZENSHIP
- PRODUCT COST
- EMPLOYEE SAFETY
- CONSERVATION

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

10.1.11

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**

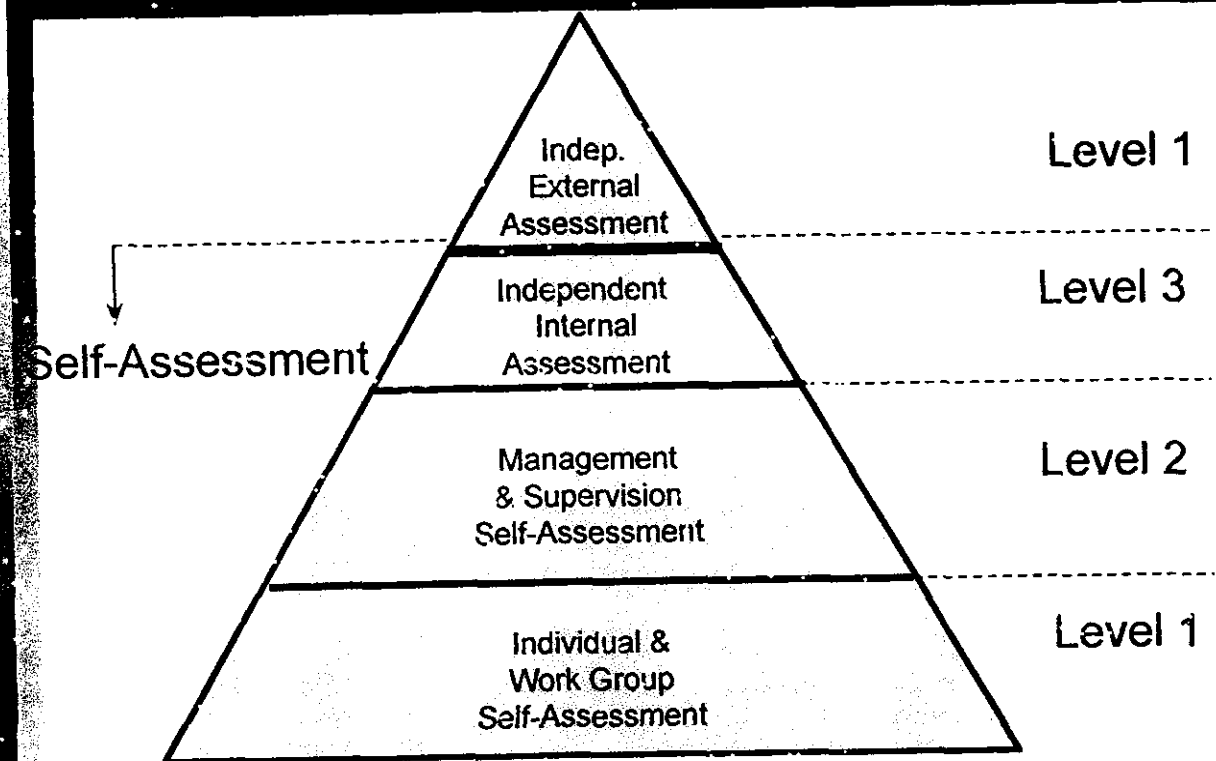
MAINTENANCE PROCEDURES

- 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