THAI - CANADIAN
NUCLEAR HUMAN RESOURCES DEVELOPMENT
TRAINING PROGRAM

EFFECTIVE TECHNIQUES

IN

HOUSEKEEPING, MATERIAL CONDITION

AND INDUSTRIAL SAFETY

OF

NUCLEAR POWER PLANTS

LECTURE NOTES FOR THE COURSE ON

PEER EVALUATION TECHNIQUES

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HOUSEKEEPING, CLEANLINESS, MATERIAL CONDITION AND INDUSTRIAL SAFETY

1.0 OBJECTIVE OF PRESENTATION

Standards used to determine housekeeping & cleanliness quality are identified. The reasons for ensuring good performance in these areas are included. Methods used to establish & sustain good standards are identified. The impact of poor standards on access to equipment, employee safety & morale is discussed. How the material condition of the plant can be established, upgraded and controlled is identified. The importance of minimising out of service alarms, controls, equipment & systems is emphasized. The elements of a good industrial safety programme are identified. Management activities necessary to sustain such a programme are indicated.

2.0 GENERAL

Housekeeping, cleanliness, material condition and industrial safety are closely linked subjects. The degree to which they are effectively managed is an indicator of the safety culture at the plant.

Housekeeping, cleanliness and material condition programs refer to the processes which ensure facilities, equipment, work areas and access routes are kept in good condition. This condition is required to support safe and reliable operation and maintenance during normal plant operation. Additionally, emergency plant operations must not be inhibited.

Housekeeping, cleanliness and material condition are interrelated. Reaching a good standard in one of them is difficult without reaching a good standard in them all.

Material condition refers to the degree to which systems and equipment are kept in a well maintained state. Housekeeping refers to the degree to which the nuclear power plant is safely accessible and operable, and is expected to remain in that state. Cleanliness refers to the prevention of accumulation of dust and debris.

For example, if there is a significant number of leaks from systems, then material condition would be impaired. Similarly, if poor housekeeping results in uncontrolled fire hazards, then the plant cannot be said to be expected to remain in an accessible state. If plant system components, such as pressure switches or rotating equipment have significant amounts of dust or debris on them, then poor cleanliness exists.

3.0 HOUSEKEEPING AND CLEANLINESS

Housekeeping and cleanliness are important in their own right. Additionally, they are also very visible indicators of the general standards of quality at a facility. The standards of housekeeping and cleanliness are often the first impressions that are observed by visitors. Poor standards in these areas will influence how the plant is perceived in many other areas of activity.

Experience would suggest that housekeeping and cleanliness are either getting better or getting worse. If there is not an active program to improve them, then they are probably deteriorating.

3.1 Standards

Consistently good standards of housekeeping and cleanliness require the identification of the desired standards in station documentation. This documentation should include an explanation of why the standards are necessary and should be part of the continuous training program for all staff. It is clearly the workers who will do most of the housekeeping, so it is imperative that they understand the standards and are motivated to carry them out.

Additionally, the supervision and managers at the plant must routinely carry out inspections to reinforce the standards. If senior plant personnel pass by a housekeeping or cleanliness problem without initiating corrective action, then they have indicated that the situation is acceptable to them.

While it is a good principle that all plant personnel from the plant manager down accept that they are responsible and accountable for these issues, it is desirable that specific groups are given specific area responsibilities and the authority to enforce the standard. Although responsibility for a specific unit or area should be assigned to a specific group. this does not mean that they are expected to clean up after others. However, they are expected to ensure that the problem is corrected. The basic principle is that whoever creates a housekeeping or cleanliness problem fixes it.

As with many other aspects of nuclear plant operation, there is ultimately less work involved in maintaining high standards than in maintaining poor standards. The hard work is involved in making the transition from a poor standard to a high standard. Since this often involves a change in the culture at the plant, it requires frequent reinforcement of the desired standard over a long period of time.

As an example of the premise that it is more difficult to sustain a poor standard, consider the situation where a mechanic no longer needs some packing material. If he is surrounded by other debris, he will probably just drop the packing material on the floor, thus increasing the problem. If he is in a clean environment, he is much more likely to tidy up after himself, thus sustaining the standard.

Some examples of conditions which would exist at a plant which had good levels of housekeeping and cleanliness would be:

- good physical characteristics and environmental conditions are present;
- cleanliness and order are evident throughout the plant;
- portable equipment, such as ladders, scaffolding, heavy maintenance equipment and fire extinguishers are stored in designated areas when not in use;
- work areas are tidy with equipment and materials neatly laid out;
- equipment and systems are free of significant amounts of dust and debris;
- access to equipment is not impeded by scaffolding or equipment laydown areas;
- trash containers are readily available and are not overflowing;
- parts and material are not laying about in inactive work areas after work is complete;
- incompatible chemicals are not stored in close proximity to each other;
- radioactive material storage areas are correctly identified and uncluttered;
- protective equipment storage areas are well stocked and tidy;
- pools of water or oil are not evident on the floor areas.

There are many other examples. This list is developed from typical problems which have been encountered at nuclear power plants.

Some plants have interpreted good housekeeping and cleanliness as requiring an extensive and costly painting and polishing program at the plant. In the author's opinion this is not necessary, unless it is perceived to be an effective way of bringing about a cultural change.

Good housekeeping and cleanliness standards are difficult to maintain because they are pervasive problems. Additionally, a few individuals who are not committed to maintaining the standard can make a significant difference.

Experience indicates that continuous, unrelenting management attention to this issue is necessary to achieve and maintain the desired standard.

Elements of the management process which have proven effective in dealing with this issue are:

- a clear indication of the desired standard. In addition to a documented standard, it is helpful to set up an area of the plant which has been brought to the desired standard and is maintained at that standard. This is an effective visual training aid. It should be set up in an area which is frequently seen by many plant personnel so they are reminded of the desired standard;
- a thoughtful training program, which helps people understand why housekeeping and cleanliness matter to them. This may include a discussion of people being injured as a consequence of poor housekeeping, for example;
- a sense of competition between the groups which have responsibility for various areas;
- provision of the necessary resources, both in people and equipment, to achieve the desired standard;
- monitoring of the status of housekeeping and cleanliness on a regular basis both by line management and quality assurance personnel. This has included the dedication of one half day per week to a detailed area inspection by a senior manager with the group leader responsible for that area;
- reporting on and rewarding successes, and identifying areas of continuing challenge.

In summary, the achievement of good cleanliness and housekeeping requires application of the complete management process. Anything less than that is unlikely to meet with success.

4.0 MATERIAL CONDITION

Maintaining good material condition at a plant requires the attention of many aspects of the organization.

They are:

- a design engineering group which gives maintainability the appropriate priority in the design process;
- a vigilant operating staff who recognize small defects before they develop into major defects. It is self evident that defects cannot be fixed until they are recognised;
  - a user friendly defect reporting system;
  - managers and supervisors who encourage the reporting of defects;
  - a responsive work planning process;

- an appropriately sized maintenance section;
- a responsive process for isolating plant for maintenance;
- an appropriate stock of spare parts and maintenance materials;
- good maintenance procedures;
- a responsive maintenance engineering group which monitors maintenance trends and chronic maintenance problems and responds to them. It is often true that a large percentage of the maintenance effort is absorbed by a relatively small percentage of the plant components. Concentrating engineering effort on the identification and resolution of these problems can result in major improvements in material condition;
- a tracking mechanism which enables the maintenance backlog to be monitored;
- a correctly balanced preventive maintenance and breakdown maintenance program;
- a methodology to ensure all plant systems get the appropriate preventive and breakdown maintenance attention in a cost effective way. Integrated operational planning is used for this purpose in Canada. Reliability centred maintenance can also be a helpful tool.

4.1 Standards for good material condition

It was stated earlier that good material condition cannot exist without an effective process for identifying defects. In order to ensure that defects are being effectively identified, there should be a periodic audit. This audit would identify, by observation, a comprehensive list of defects existing in the plant, or an area of the plant. This list would then be compared to the defects which are actually captured by the defect reporting system. A minimum acceptable standard would be that greater than 70% of the defects are captured by the defect reporting system. This includes small leaks or high vibration, for example, which may not result in the equipment being unavailable for service.

The size of the backlog of defects identified in the defect reporting system is also an important measure of the quality of material condition at the plant. Some backlog is inevitable, since time is required to arrange to take the equipment out of service, organize the work and obtain spare parts, etc. An acceptable target might be no more than one month's backlog for non outage work. Of course defects on critical systems would be fixed with the highest priority, which would be much faster than that, often on the same day.

The impact of the backlog on plant operation, both under normal and emergency conditions is also important. For example, if a significant number of control room alarms are unavailable, or constantly in the alarm state, then this would impact on the operator's ability to effectively monitor plant conditions. Similarly, if the backlog resulted in important standby equipment being unavailable to the operator then this would indicate unsatisfactory material condition.

Personnel safety or access to equipment can also be impacted by poor material condition. For example if a large steam leak prevents safe access to critical plant components, or if there are puddles of water or oil around the plant, then this is also indicative of poor material condition.

5.0 INDUSTRIAL SAFETY

The operating organization should have a general policy on industrial safety, which includes the measures taken to ensure the industrial health and safety of personnel on the site is satisfactory. All elements of this safety policy should appear in a plant safety manual while details should be included in implementing procedures.

The industrial safety programme should be understood and adhered to by all personnel on site. All personnel on site should be made aware of their individual responsibilities with respect to these safety provisions.

The operating organization should appoint a suitable committee to provide an independent overview of plant conditions. People are the most important part of a strong industrial safety programme so peer representation on the committee should provide for open discussions and expedient change to unsafe practices.

Routine safety meetings should be held at which plant personnel receive feedback on industrial safety issues or are given an opportunity to discuss their concerns. Industrial safety performance indicators should be reviewed.

The organization should have arrangements in place which require evaluation of health and safety risks prior to start of work. Consideration should be given to a programme of risk management and the creation of a facility which allows for rewarding staff who actively contribute to the safety ethics.

The policies, programmes and procedures must be written and responsibilities assigned to ensure industrial safety in the work place. The following elements should be considered:

- Electrical and mechanical evaluation of tools
- Protective clothing and equipment use
- Eye protection equipment including eye wash facilities
- Storage, use and disposal of hazardous chemicals
- Storage, use and disposal of hazardous substances (asbestos)
- Confined space entry
- Climbing equipment
- Scaffolding
- Lifting equipment
- Access and opening guards
- Training
    - industrial safety programme
    - first aid
    - fire fighting
    - heat stress
    - respiratory protection

The industrial safety programme should contain the requirement to periodically evaluate the programme and the procedures. In addition a surveillance programme for testing all industrial safety hardware on a set frequency must be in place.

When a safety officer is included in the site organization the duties, responsibilities and authority of the position should be specified in writing. The safety officer should report to line management at the requisite level to ensure sufficient authority and freedom of action in all

areas on site. If an industrial safety organization exists it should have a clear organizational structure identifying functions, responsibilities and communication links. If no safety official or organization exists then there should be an alternative allocation of responsibilities to ensure the avoidance of interface problems and to make provision for independent review.

A peer or safety committee overview should be in place and programmatic changes must be assessed and implemented as expediently as possible.

The industrial safety training requirements for plant staff and contractors must be identified and effectively carried out.

Routine safety meetings for plant personnel should be conducted. The effectiveness of these safety meetings should be periodically assessed by reviewing the subjects discussed and the extent to which information is communicated to personnel.

Routine inspections of selected areas and activities on the site should be undertaken by all levels of supervision and management. These inspections would determine whether the safety rules, procedures and instructions are being adhered to satisfactorily. Points of particular significance should include current validation of safety equipment, such as fire extinguishers and breathing apparatus. Industrial safety requirements should be specified on a work authorization. The material condition of infrequently used safety equipment such as showers or fire escapes should be monitored. Priority assignment should be given to any backlog of identified deficiencies in industrial safety work.

A requirement for job preplanning should exist in the area of industrial safety. Root cause evaluation should be carried out for accidents and analyzed for trends to determine if preventive measures are needed.

6.0 OSART EXPERIENCE

Housekeeping, material condition and cleanliness are generally found to be quite well done. Findings are often associated with areas which are not frequently visited or they are associated with a threshold problem. The threshold problem means that lower level defects are not reported and corrected but major defects are effectively dealt with. Industrial safety management effectiveness varies according to the culture of the country being visited.