Examples of Complexity for MCR Abandonment Action

Example Plant A, Base Case:

The plant has two remote shutdown panels (RSDP), one for train A equipment and one for train B equipment. Either panel is capable of providing all required instrumentation and control to shut down the plant. The panels are in close proximity (adjacent rooms, but separated by a qualified fire door so they are in different fire areas). The rooms are small and quiet.

All actions required to enable the panels for a fire in the MCR (i.e., the command and control transition actions) are accomplished by means of a bank of disconnect switches in the relay room. Upon leaving the MCR, the PCS operators pass through the relay room and throw all switches on the panel.

Most actions for shutdown are accomplished at the RSDPs, but in addition there are certain local actions that are required. Field operators perform the following:

- FO-1; Locally trip RCPs
- FO-2; Locally maintain SG pressure at 1000 psig using SG PORVs to control natural circulation
- FO-3; Locally trip main feed and condensate pumps

The complexity assessment answers the following questions:

- Are there many alarms or indications to which the crew or operator must identify, evaluate, and respond? No, because the crew is forced to evacuate due to the fire. They will be using the limited alarms and indications at the RSDP.
- Will communication between several individuals at different locations be necessary? Minimal. Communication between the RSDPs, if needed, is direct verbal. With the door between the RSDPs open (this is permitted if there is no fire on either side), this can be considered a single location. The local actions to trip pumps do not require communication until they are completed. The only continuous communication is with the operator at the SG PORV.
- Will plant symptoms be difficult to ascertain because of instrumentation failures and spurious indications? No, because the instrumentation at the RSDP is unaffected.
- Will component failures have multiple or propagated effects on systems, equipment, or other components? No.
- Will the action sequence include concurrent tasks that require specific timing to be successful? Minimal. The pump trips do not require specific timing. The operation of the SG PORVs requires coordination, but success is not dependent on precise timing.
- Will the situation include many distractions, crowds of people, or other factors that could divert attention from the required tasks? No. Most actions are conducted at the RSDPs, which are in small, quiet rooms. The local actions are not expected to take place in the presence of distractions.

Other complexity considerations:

- Communications – The plant has a hardened, hard-wired communication net, which will ensure quality communications.
- Training – All operations staff are trained in these operations bi-annually

Complexity: Nominal

Example Plant A, Variant Case 1:

Base case except communication is handled by radio, which at this plant can be garbled and hard to understand due to internal plant interference.

This is not a significant enough difference to change the assessment. The only continuous communication required is to control the position of the SG PORV. This is not sensitive to small amounts of delayed response since the SG pressure control does not have to be overly precise. Also, the commands are simple (open valve, close valve).

Complexity: Nominal

Example Plant A, Variant Case 2:

Base case except assume that the actions of the S/G PORV operator are every time sensitive, and must be completed and confirmed back within one minute of receipt of instruction from the RSDP operator.

This is not a significant enough difference to change the assessment. The only continuous communication required is to control the position of the SG PORV, and while it is now sensitive to small amounts of delayed response. The commands are simple (open valve, close valve) and the quality of the hard-wired communications is excellent.

Complexity: Nominal

Example Plant A, Variant Case 3:

Base case plus both variant case 1 and 2 both exist (garbled radio communication and time sensitive response required).

In this case, the combination of the two previous cases when taken together is a significant complicating factor.

Complexity: Degraded

Example Plant A, Variant Case 4:

Base case except assume that the actions of the three field operators must be performed in a particular sequence, and so they must communicate with each other through the command and control operator at the RSDP.

The coordination of the actions of three different individuals by a fourth individual, even with good communication equipment and training, is a significant complicating factor. Multiple three-way communications must take place and be properly implemented.

Complexity: Degraded

Example Plant A, Variant Case 5:

Base case except that control and monitoring of AFW flow is not available at the RSDP. The operator that locally trips the RCPs then proceeds to a local station where he controls and monitors AFW flow and reports it to the operator at the RSDP.

Although the area where the AFW pump flow control resides is likely to be noisy, the quality of the hardwired communication system will reduce the likelihood of confusion. The operator at the AFW is both controlling and monitoring flow, so communication will be infrequent requests to change the flow rate. The addition of one more local operator communicating with the RSDP is not significant, since the overall frequency of communications is low and the commands simple.

Complexity: Nominal

Example Plant A, Variant Case 6:

Similar to variant case 5, except that monitoring of the AFW flow is not available locally – it is only at the RSDP. Therefore, the operator that locally trips the RCPs then proceeds to a local station where he controls AFW flow under instruction from the operator at the RSDP.

Although the area where the AFW pump flow control resides is likely to be noisy, the quality of the hardwired communication system will reduce the likelihood of confusion. However, the operator at the AFW is only controlling flow, so there will be “flurries” of communication and feedback to match the actual flow with the desired flow rate. Still, because of the clarity of the communication systems the overall operations with both the SG PORV operator and AFW operator, neither of which are extremely time sensitive, is not overly complex.

Complexity: Nominal

Example Plant A, Variant Case 7:

Similar to variant case 6, except that communications are by radio, which at this plant can be garbled and hard to understand due to internal plant interference.

This additional complication (garbled communication) combined with the need to communicate with two local operators, one of which will receive flurries of communication when adjusting AFW flow rate, is enough to make this overall operation more complex even though the individual actions are not overly time sensitive or complex.

Complexity: Degraded

Example Plant B, Base Case:

The plant has two panels used for remote shutdown. RSDP-A is for monitoring and control of secondary side cooling. RSDP-B is for monitoring and control of charging.

The operating team consists of five individuals, Operators O-A through O-E. O-A is the incident commander. Following the completion of immediate actions in the MCR, the team assembles at the Appendix R locker. Radios and procedure attachments are distributed, and each operator proceeds to follow their assigned actions.

O-A: Remains in the main procedure. Proceeds to perform some actions to disable certain DC control panels and then proceeds to the TSC, which will be the command center. O-A monitors and directs the activities of the other four operators from the TSC.

O-B: Locally trips Rod Drive MG sets and RCPs, and then proceeds to location of safety bus A. Pulls control fuses and isolates bus. Informs O-C that bus is isolated. Waits for instruction from O-C to proceed. Upon instruction, manually connects bus to DG and starts SW pump. Notify OA-E to proceed. Complete additional local actions and notify O-A that they are complete.

O-C: Proceeds to DG and takes local control of DG, assuring it is off and isolated. Notifies O-A. Awaits notification that from O-B and O-E that safety busses are isolated. Upon notification, starts DG and informs O-B to proceed to energize bus and start SW. Notifies O-A diesel is running. Monitors DG for any alarms, and when stable joins O-D to provide assistance if needed.

O-D: Proceeds to MSIV area and assures MSIVs closed. Proceeds to RSDP-A and activates. Starts and aligns TDAFW. Monitors and controls SG level using TDAFW. Notifies O-A the actions are complete and level being maintained.

O-E: Proceeds to area of safety bus B, pulls control fuses and isolates bus. Performs other local actions in the same vicinity. Returns to safety bus and awaits instruction to proceed from O-B. Upon instruction, manually energizes bus. Proceeds to area of charging pump, and activates RSDP-B. Aligns charging and starts pump, establishes flow to maintain pressurizer level. Notifies O-A level is stable. Performs additional local actions. Notifies O-A actions are complete.

The complexity assessment answers the following questions:

- Are there many alarms or indications to which the crew or operator must identify, evaluate, and respond? No, because the crew is forced to evacuate due to the fire. They will be using the limited alarms and indications at the RSDPs and local stations.
- Will communication between several individuals at different locations be necessary? Yes. There will be five individuals at different locations. There will be extensive communications between four of them (only one operator will independently perform his actions a simply report completion at the end).
- Will plant symptoms be difficult to ascertain because of instrumentation failures and spurious indications? No, because the instrumentation at the RSDPs and local stations is unaffected.

- Will component failures have multiple or propagated effects on systems, equipment, or other components? No.
- Will the action sequence include concurrent tasks that require specific timing to be successful? Yes. Three of the operators have hold points while other operators are performing actions, and the hold points and release points must be communicated between the operators.
- Will the situation include many distractions, crowds of people, or other factors that could divert attention from the required tasks? Possibly. A number of actions take place in the vicinity of possible noisy equipment that could make concentration and hearing difficult.

Other complexity considerations:

- Communications – The communications are all handled by radio. There are dead spots in the plant and other potential for noise and interference with the radio transmission.
- Training – All operations staff are trained in these operations bi-annually

Complexity: Degraded

Example Plant B, Variant Case 1:

Same a base case except that a dedicated, hard-wired communication system is installed at each RSD location.

While this would provide a higher quality communication and less potential for misunderstanding, this is insufficient to compensate for the high level of coordination between actions that is required.

Complexity: Degraded

Example Plant B, Variant Case 2:

Base case except that controls for isolating and reloading the safety busses are located at the DG local control panel. Therefore, O-C can perform all actions to energize the safety busses from the DG panel. O-B and O-E do not have to perform any actions except to start the SW pump and the charging pump when notified by O-A (who will be notified by O-C) that the busses are powered.

While this does eliminate a number of operator-to-operator hold points, there is still a need for coordinating and sequencing communication, and it is also through a third party not at any of the stations (O-A).

Complexity: Degraded

Example Plant B, Variant Case 3:

This is the same as variant case 2 above, but in addition to having more operations at the DG panel, command and control will be handled at the DG panel (O-A will be there in addition to O-C) and any parameter monitoring functions used in the TSC will be provided at the DG panel.

This eliminates another round of communication by having O-A at the DG location able to observe successful completion of the energizing of the busses. This additional simplification, which reduces the release point to O-A telling O-B and O-E to proceed, is sufficient reduction of complexity.

Complexity: Nominal

Example Plant B, Variant Case 4:

Combination of variant case 1 and variant case 2 (hard-wired communications and more actions located at DG panel).

This improves the communication under variant case 2 sufficiently to compensate for the additional communications required because of O-A being at the TSC. This incremental improvement is sufficient to reduce the complexity.

Complexity: Nominal

Example Plant B, Variant Case 5:

Same as variant case 1, except that all members of the operations staff who might have a function during a MCR abandonment (would serve as an O-A through O-E) is conducted on a quarterly basis.

The combination of the hard-wired communication system plus very frequent training would result in a situation where the quality of the communication plus the essentially constant reinforcement of the procedure would compensate for the otherwise complex series of actions.

Complexity: Nominal