Appendix 3 Operator Survey Form

This appendix shows a form that may be used to assess an Operator's views on their existing HCI. This can be a useful method of determining where problems exist in a HCI.

Survey of Process Systems Human Computer Interfaces (HCI)
Questionnaire for Operators

Insert here text explaining the questionnaire. This should typically include:

Why the survey is being carried out?
What is the purpose of the survey?
Whether the survey is confidential?
Who is carrying out the survey?
Where to return the survey forms?

The following is example text:

This questionnaire forms part of a study aimed at understanding the issues associated with using 'soft-desks' - i.e. process control systems operator desks that are fully computerised and just use computer displays for displaying information to the operator. In particular it is concerned with the number of display units available to the operator and the ease with which the operator can navigate through the system in order to retrieve information. All information received through this survey will remain anonymous.

This questionnaire is aimed specifically at your impressions from operating the plant. It is concerned with the number of physical display screens that are available, navigation around the display format hierarchy and the usability of the system.

Any extra comments or information that you may wish to add will be gratefully received.

Many thanks for your time and understanding.

Company:	Site:
1. What is your job and on what plant/unit?	
2. How long have you worked on this plant/unit?	Yrs Months
3. How many physical screens are available to you?	Screens

4. Is the physical arrangement of the screens satisfactory? If not, how could this be improved?	Yes	No
5. How many individual graphic layout graphics are available on the system?		Graphics
6. How many screens do you usually keep with the same fixed graphic and how many do you vary?	Fixed	Variable
7. How many screens do you typically, actively use: When the plant is in steady state? When the plant is starting-up? When the plant is in an abnormal situation? (e.g. trip)		Screens Screens Screens
8. Do you find it easy to navigate through the graphic hierarchy? Any Comments?	Yes	No
9. How many operations (e.g. 'mouse clicks') does it typically take for you to get to the graphic you wish to view?		Operations
10. Can you display all the information that you need to do your job ? In steady state conditions In start-up conditions In abnormal situations (e.g. trip)	 Yes Yes Yes	 No No No

11. In abnormal situations, can you navigate through the graphic hierarchy quickly enough?	Yes	No
12. Do you ever 'get lost' in the graphic hierarchy?	Yes	No
13. Is the amount of information displayed on each graphic: Too much About right Too little		
14. Would having more physical screens help?	Yes	No
15. Does your system have large overview screens?	Yes	No
16. If 'NO to Question 15' then - Do you think having large overview screens would help you?	Yes	No
17. Could the navigation around the system be improved?	Yes	No
18. Would you prefer to use a different device to a 'mouse'?	Yes	No

If you have any other comments on screen number, graphics or navigating through the display hierarchy, please write them on the blank sheet below:

Appendix 4 Operator Task Review Questionnaire

The aim of the questionnaire is to gain knowledge about the tasks and activities that are undertaken by the control system operations staff.

Company:	
Location:	
Plant:	
Date:	
Name: (not required)	
Role:	

1. How long have you worked with the present control/ alarm systems?		
Years/ Months		
Have you worked with other systems? If so, which ones?		

2. Task description
What systems are required to fulfil this task?

How often is the task undertaken?	
How long does it take to complete the task?	

Does the task need to be done quickly or under a high stress environment?

3. Task Goal / objective
Is there a need to involve other staff? If so, who?
How is communication between other staff undertaken?

4. Procedure: Is there a written procedure for this task?	
Procedure Reference:	
Does the procedure reference the control system? If so, how?	
Does the procedure describe the consequences?	
Are there alternative routes to fulfil the task?	
Are the consequences of alternative routes understood?	
5. Control System: What facilities have been provided to undertake the task?	
What displays are used?	
Are the displays specifically designed for this task?	
Does the display follow the sequence of events?	
Is colour used to indicate problems?	
Are alarms used either to assist the progression of the task or to detect mistakes?	
Typically what other task or interruptions could influence this task?	
Is there easy navigation to other displays?	
Can any of the information on the displays be misleading?	

6. Task History
Does the task have a good history of being completed correctly?
Typically, what could go wrong?
Typically, what has gone wrong?
Do all operators undertake the task in the same way?
7. Improvements: What other facilities would help you undertake the task?
What features would you add to help you run the plant?
Are there any parts of the task that could be misleading? What features would you remove because they don't help?
8. Do you have any other comments that might help improve the task?

9. General Notes
Record questions asked and any other relevant questions. Also record any follow up actions that the interviewee has requested.

10. Additional questions

Appendix 5 Example Refurbishment Design Strategy

This appendix outlines the processes that need to be followed in creating a new HCI control desk for an existing installation.

When refurbishing an existing plant and upgrading from a hard-desk to a HCI, some confidence can be taken from the fact that the operating mode of the plant is well known and the use of the indications well understood. This gives a basis for developing the new HCI graphics hierarchy and navigation. It can be very beneficial to question the existing methods of performing tasks - i.e. why is the task performed this way? Do we need all these indications? Are they actually used, etc? This can lead to a simplification of the process or at least a better understanding. An additional approach can also be to define new ways of approaching tasks, so that the HCI does not become just a replica of the hard-desk. The opportunities offered by the technology can thus be exploited.

An outline of the process that can be adopted in moving from a hard-desk to the HCI is as follows:

- Collate Existing Information
  Obtain current panel information, controls, indicators.
  Obtain current VDU display formats - if any exist.
  Obtain current alarm information.
  List emergency scenarios and collect information on existing procedures.

  This information will enable a proper analysis of the requirements to be performed. The use and reason for indications can be questioned and a checklist of all required indications produced to ensure that the new desk covers all requirements. Knowledge of existing procedures will allow for task-based graphics to be developed or new ways of displaying the required information to be formulated.

- Design HCI standard
  Include guidelines on aspects as detailed in Section 2.1 Control Room Design Factors of this guide.

- Design Overview Displays
  Analyse information required.
  Limit to major indicators giving overall plant status (e.g. safety, efficiency, environmental).
  Indicate major plant in/out of service.
  Consider major alarm information.
  Design for graphic, rather than numeric indication.

  Information collected in the previous step is crucial for this next stage.

- Define overall Hierarchy of system
  Define all major plant area graphics required.
  Define all lower level more detailed graphics.
  Define control action graphics required.
  Define navigation between graphics.

The procedure uses a top-down methodology, understanding the 'bigger picture' before moving down to see the detail that is required and should follow the process flow.

- Design Graphics
  Analyse information required on each graphic.
  Analyse auxiliary plant and services related to this plant item.
  Check alarm indication required.
  Identify button access to related graphics.

  At this point individual graphic design is important with an emphasis on clarity and consistency. The navigational methods must be incorporated onto the screens.

- Design Control Graphics
  Identify all control actions needed for particular plant items.
  Identify requirements for 'group' control.
  Identify any control actions that are difficult to translate from hard-desk (e.g. two-handed operations, parallel operation).

- Design Trend graphics
  Collate information about existing chart recorders.
  Identify additional trend requirements.
  Define variables, time-base, scales.

- Define alarms
  Consult EEMUA alarm guidance document [1] .

  The design of alarms is a huge topic in its own right. The document referenced provides invaluable guidance on this issue. It must be recognised that alarm system design can be time and resource intensive. However, if a HCI is to be the only operator interface then it is crucial for this to be performed properly.

- Build complete system (or prototype a small area)
  To allow for review.

- Review for acceptance
  Check against designs.
  Check guidance conformity.
  Check pop-ups.
  Check control actions.
  Check graphic linkage.

  This formal off-line testing can result in significantly less problems at the commissioning stage.

- Commission
  Check graphics against actual plant-state.
  Check controls result in the desired action.
  Check alarms are correctly connected to graphic.

Appendix 6 Control Room Noise

A6.1 Acceptable Noise Levels

Noise is measured in decibels (dB). An 'A-weighting', sometimes written as 'dB(A)', is used to measure average noise levels and a 'C-weighting', or 'dB(C), to measure peak, impact or explosive noises. The scale is logarithmic so that a 3 dB change represents a doubling of noise level.

For reference, some typical noise levels encountered in everyday life are:

- Quiet library – 20-30 dB
- Quiet office – 40-50 dB
- Conversation – 50-60 dB
- Loud radio – 70-80 dB
- Power drill – 90-100 dB

(Source: HSE Noise at Work Guidance for Employers on the Control of Noise at Work Regulations, 2005)

The GB Health and Safety Executive (HSE) Control of Noise at Work Regulations 2005[15] specifies noise exposure action values of 80 dB (lower action value) and 85 dB (upper action value). Specific actions are mandated which the employer must take if average daily/weekly noise levels reach these thresholds. The regulations also specify an average daily/weekly exposure limit of 87 dB. It is apparent that the noise level within the control room environment should fall well below these health related exposure limits.

The US Nuclear Regulatory Commission - Human System Interface Design Review Guidelines (NUREG-0700)[16] specifies that background noise levels within control rooms should not exceed 65 dB(A). At this background noise level, operators eight feet apart will have to speak loudly to be heard intelligibly. As background noise levels fall below 60 dB(A) operators can communicate over this distance in a normal voice.

The HSE control room design guidelines suggest that a background noise level below 40 dB(A) is not desirable as it may cause interference between operators. The guidelines also suggest that audible alarm signals should be at least 10 dB(A) above the control room background noise level.

A6.2 Sources of Noise

There are many potential sources of background noise within the control room environment:

- Communications systems (telephone, radio, PA announcements);
- Cooling fans for consoles and other electronic equipment;
- Printers, photocopiers and other auxiliary equipment;
- Alarm systems;
- HVAC systems;
- Non control room staff gathering in, and passing though, the control room;
- Noise from external plant;
- Noise from adjacent rooms;
- Cleaning and maintenance activity within the control room;

A6.3 Control of Noise

The following steps may be taken to reduce background noise levels and prevent any significant noise distraction above ambient noise levels within the control room:

- Good acoustic design of the control room. Design the control room using materials and finishes that give good acoustic properties and reduce the airborne noise from sources within the control room. Specify the use of sound absorbent ceiling tiles, acoustic wall panels and sound absorbing floor coverings. Pay attention to the acoustic properties of the console itself and the area around the console. Identify and eliminate any sources of reverberation within the control room. Ensure the control room is also adequately insulated from external sources of noise.

- Locate equipment outside control room. Consider which equipment it is essential to locate within the control room. Where possible locate equipment outside the main control room environment.

- Specify low noise equipment. Consider the noise output when specifying items which must be located in the control room.

- Restrict access to control room. Apply firm policies to manage access to the control room and traffic through the control room. Ideally operators should have control over access. Provide areas outside the control room where activities not directly associated with operating the plant can be carried out (e.g. general plant discussion, risk assessments, permits issue, etc.). Provide a separate area where engineering and configuration work can be carried out on the system without impacting the control room operators. Establish a protocol for contacting and communicating with the operators. Establish a policy for controlling visitors to the control room.