

## **Analysis of control panel**

### **Use of colour**

Red represents danger (cultural, but pretty universal), so good to represent alert state and for emergency shutdown and confirm button. Similarly green represents safety. In UK and some countries green/amber/red also used for traffic lights, and alarm panel reflects this (recruiting real world knowledge). Red also good to grab attention and seems 'close' (visual perception and 3D vision), so good choice for making CONFIRM button obvious when it needs to be pressed

But . red/green colour blind users would have some problems. The alarm state indicator is fine as colour is a redundant cue and can simply use location, but perhaps text label would help. The confirm button however fails completely as the only way of telling it needs to be pressed is the green to red colour change which would be invisible. Perhaps making it red and flash would be better

### **Layout**

The sub-panels give some logical grouping, especially good for original alarm control, but spoiled a bit with revised alarm behaviour where the CONFIRM button is part of the same logical interaction – perhaps an additional CONFIRM button on the Alarm panel would have been better. The location of Emergency shutdown immediately above the CONFIRM does emphasise both grouping and sequence, but perhaps should either be part of same panel or have a line/coloured box drawn on the control panel linking them.

The manual override controls are all grouped together, but the position and layout of the keypad are unusual (?problems for left handed users). The normal sequence is select target, move right to the keypad (OK for most European settings), but then back left again for SET button, perhaps the last a little unnatural. Again linking the three sub-panels with a drawn box or colouring them could increase the emphasis that they have a common function. The main sequence/grouping problem is that they are only enabled in red mode hence changes to them involve going back and forth across the control room.

In general it seems the uniform size of the sub-panels is causing some problematic design choices.

### **Other potential improvements**

Have a separate CONFIRM button on the Alarm control panel, making it flash so it is more readily seen in peripheral vision. Distinguishing red from temporary red state by perhaps flashing the red light would also help prevent the initial mode error. Also, when the user tries to select a target and enter a value, a warning of some sort should be issued. This could simply be a 'this doesn't work' beep, but better would be a warning written on the manual override panel with perhaps lights up when not in RED alarm state.

## Annotated scenario

[[ *Original text in italics to aid reading, the expected answer is in normal type. This is a very full answer. This situation mirrors quite closely a mode and closure error in Excel that we discussed at length in class.* ]]

Note: Jenny has been 6 hours on a night shift, so errors are likely especially under stress.

1. *Jenny notices the core reaction rate has risen very rapidly*  
one perhaps wonders why this wasn't noticed earlier, perhaps a problem in positioning of displays?
2. *she realises she must immediately change the reactor target ...*  
OK
3. *she goes to the Alarm Control Panel ... presses '+' twice*  
Jenny has remembered that she needs to be in RED state to use manual override
4. *the Emergency Confirm button glows red*  
OK, Jenny should press CONFIRM now, but having pressed then '+' and seen the RED alarm state light glow she gets the 'aha' feeling of closure and forgets to press CONFIRM. The red CONFIRM button is intended to remind her but ...
5. *she moves across to the Manual Override panel ...*  
clearly Jenny didn't notice the CONFIRM button, presumably because it is at the bottom of the panel and she is looking at the Alarm control at the top. Peripheral vision is good at black and white (contrast) changes, but not colour.
6. *she selects 'Pressure' from the pull down on the Manual Override panel*  
which won't work because she is in the wrong Alarm state – this is a mode error caused by the original closure error, but when she is at the far left of the control panel the current system mode (temporary red alarm state) is not visually (or audibly clear).
7. *she types the new value '6000' using the keypad*  
and forgets to press SET – another a closure error
8. *she notices that the number on the Reactor Targets panel has not changed*  
happily she does double check this rather than simply moving on which would have easily been possible
9. *she realises she forgot to press the SET button on the Manual Override panel*  
OK realises this one, perhaps because of better logical grouping
10. *she presses the SET button*  
OK, but ...
11. *the value still doesn't change*  
still in wrong mode (alarm state temp red)
12. *an automatic audio warning sounds "60 seconds to core meltdown"*  
good choice of warning modality to use sparingly for critical information. In a big control room a visual alarm would easily be missed.

### Annotated scenario (ctd.)

13. *she presses the SET button repeatedly*  
typical user reaction, happily doesn't cause bad effects!
14. *still the value doesn't change*  
still in wrong mode and despite repeated failure still doesn't think of a mode error – which is normal behaviour in error situations – the expected mode is part of the assumptions she brings to her problem solving
15. *she starts again, selects 'Pressure' from the pull-down, types 6000 and presses SET*  
presumably thinking that the previous part-finished action sequence before 'confused' the system
16. *still the value doesn't change*
17. *the audio warning says "30 seconds to core meltdown"*
18. *Jenny runs across the room to the Emergency Shutdown panel*  
no, still doesn't realise that the problem is the wrong alarm state, but now aiming to shutdown the reactor to avoid meltdown
19. *"20 seconds to core meltdown"*
20. *she presses "Immediate Emergency Commence" button*  
correct action in dire emergency
21. *the emergency confirm button glows red*  
but this time is close to the button she has just pressed (in fact it would have already been glowing when she got there, but perhaps didn't notice as she was running and stressed) and so this time she notices the CONFIRM button ...
22. *"10 seconds to core meltdown"*
23. *she presses the "Emergency Confirm" button*  
... at last!
24. *she hears the crash of the explosive bolts ...*  
actually there is nothing quite so good as real physical feedback whether visual, tactile or, as in this case, audible
25. *the audio system announces "reactor shutdown successful"*  
but restarting the reactor will take weeks costing vast amounts of money!