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Guidance on Practice for Control Rooms

GP 30-55

BP GROUP
ENGINEERING TECHNICAL PRACTICES

Foreword

This is the first issue of Engineering Technical Practice (ETP) GP 30-55. This Guidance on Practice (GP) is based on parts of various project specifications from the merged BP companies.

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1. Scope

This document provides guidance for the design and layout of control rooms (CRs) and related equipment, facilities, and ancillary systems, following human-centred industry design concepts and practices. Although, some of the principles could be applied to offshore control rooms, this practice is most applicable to onshore plant facilities.

General control centre guidelines are included with the exception of civil and structural building requirements.

2. Normative references

The following normative documents contain requirements that, through reference in this text, constitute requirements of this technical practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this technical practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

BP Group (BP)

GIS 30-401	Guidance on Industry Standard for Procurement of Control Systems.
GP 12-15	Guidance on Practice for Wire and Cable.
GP 12-25	Guidance on Practice for Earthing/Grounding.
GP 12-30	Guidance on Practice for Lighting and Small Power.
GP 12-35	Guidance on Practice for UPS Systems.
GP 12-65	Guidance on Practice for Electromagnetic Compatibility.
GP 12-75	Guidance on Practice for Cable Trays and Raceways.
GP 14-XX	Guidance on Practice for Heating, Ventilation, and Air Conditioning.
GP 30-45	Guidance on Practice for Human Machine Interface.
GP 30-60	Guidance on Practice for Process Control Networks.
GP 30-85	Guidance on Practice for Fire & Gas Detection.
GP 59-11	Guidance on Practice for Telecommunications Systems for Manned and Normally Unmanned Offshore Fixed Installations.
GP 59-13	Guidance on Practice for Telecommunications on Oil/Gas Terminals, Process Plants, Refineries and Chemical Plants.

Instrumentation Systems and Automation Society (ISA)

ISA RP 60.3	Human Engineering for Control Centers.
ISA RP 60.7	Control Center Construction.
ISA S71.04	Environmental conditions for Process Measurement and Control Systems: Airborne Contaminants.

International Organisation for Standardisation (ISO)

ISO 11064-1	Ergonomic Design of Control Centres, Part 1 Principles for the Design of Control Centres.
ISO 11064-2	Ergonomic Design of Control Centres, Part 2 Principles of Control Suite Arrangement.
ISO 11064-3	Ergonomic Design of Control Centres, Part 3: Control Room Layout.



National Fire Protection Association (NFPA)

NFPA 70	National Electric Code (NEC).
NFPA 75	Standards for Protection of Data Equipment.
NFPA 101	Life Safety Code.

3. Terms and definitions

For the purposes of this GP, the following terms and definitions apply:

Control centre (CC)

Combination of control rooms, control suites and local control stations which are functionally related and all in on the same site.

Control room (CR)

Core functional entity, and its associated physical structure, where operators are stationed to carry out centralized control, monitoring and administrative responsibilities.

Control Suite (CS)

Group of functionally related rooms, co-located with the control room and including it, which houses the supporting functions to the control room, such as related offices, equipment rooms, rest areas and training room.

Local control station (LCS)

Operator interface that is located near the equipment or system being monitored and/or controlled.

4. Symbols and abbreviations

For the purpose of this GP, the following symbols and abbreviations apply:

CCTV	Closed circuit television.
CRT	Cathode ray tube.
EMI	Electromagnetic interference.
ESD	Emergency shutdown.
F&G	Fire and gas.
HVAC	Heating, ventilation, and air conditioning.
PAS	Process automation system.
RFI	Radio frequency interference.
UHF	Ultra high frequency.
UPS	Uninterruptible power supply.
VHF	Very high frequency.
WRTA	Wireless remote terminal access.



5. General

5.1. Design considerations

- a. Human-centred approach to CC and CR design shall be applied in accordance with ISO 11064-1/2/3.

The job of the operator can at times be very demanding. The consequences resulting from inappropriate operator action in control rooms, such as acts of omission, commission, timing, sequence and so on, can be potentially disastrous. Applying ergonomics and human factors on designing and evaluating control centres and control rooms helps eliminate or minimize potential human errors.

Some of the benefits of applying an ergonomic approach are:

- *Reduction of operator errors and unwanted trips.*
- *Optimisation of CC and CR logistics.*
- *Improvements in communication.*
- *Improvement of readability of graphical displays.*
- *Reduction of "reach" time.*
- *Improvement of process plant safety.*
- *Improvement of operator well-being.*

- b. CCs shall be operational according to modes defined in the control, operation, and maintenance philosophy specific for each installation.

- c. CCs design should include the following considerations:

1. Type of control equipment to be housed.
2. Number of process units to be controlled and the degree of integration.
3. Location of the building.
4. The environment in which the building is located.
5. The desired environment within the control centre.
6. Requirements for future space.
7. Office requirements.
8. Conference rooms.
9. Adequate space to perform maintenance on the equipment.
10. Space for the storage of critical spare parts.
11. Proper kitchen and sanitary facilities for personnel.

Separate toilet facilities for each sex.

12. Rest and fitness areas.

These areas are largely depending on the company policies.

13. Adequate space for storage of safety equipment.
14. Consideration for handling contaminated material in the field, cleaning up, and house keeping of the CC.

- d. CCs should provide required spaces in the sizes, relationships, and appropriate environment with consideration for technical needs of equipment, occupant comfort and safety.



- e. Control centre size shall be determined by the number of process units to be controlled, the number of operators required to control the units, a minimum complement of supervisory/technical personnel, and the amount of equipment within the building.
- f. Equipment housed in a CC might include the following:
 - 1. Field Termination or marshalling cabinets.
 - 2. Process Automation System (PAS) equipment, including consoles, I/O racks, communication racks, support equipment required by technical or maintenance personnel.
 - 3. Communication systems, including but not limited to Public Address (PA) or paging systems, VHF/UHF radio systems, telephone equipment, general purpose communications associated with Ethernet or similar communication networks, and so on.
 - 4. UPS equipment, batteries, associated switchgear, breaker, electrical panels, transformers.
 - 5. Network chromatography equipment.
 - 6. Machinery condition monitoring systems.
 - 7. HVAC and air purification equipment.
 - 8. Utility equipment such as hot water heaters where applicable.
 - 9. Computers used directly for control or management of the process.

A list of material/equipment needed, as well as the expected attendance may help estimate the number and size of rooms required in the CC.

- g. Motor control centres and large-scale power switching/handling equipment shall not be a part of a new control centre design.
- h. The location of laboratory or testing facilities within the control centre is prohibited. Any samples of material brought to the control centre for examination shall be removed as soon as the examination is complete.
- i. Any equipment installed within the control centre should be removable.
- j. Consistent with the above, corridors and hallways should be a minimum of 1.8 metres (6 feet) wide, with double doors to accommodate equipment removal if required.

The preferred design is to provide double door access directly to the equipment rooms to eliminate the requirement of moving large equipment through internal building passageways.

- k. The following task areas should be considered for the design of CC:
 - 1. Task areas for process control and supervision for:
 - a) Control and supervision for normal process conditions.
 - b) Control and supervision for off normal process conditions, including start-up and shutdown operations.

Often, additional operators and/or stations are required for off normal operations.

- 2. Documentation task area and possibly other administrative tasks, including the use of electronic aids (computer, VDU-terminal).
- 3. Administration task areas needed for shift book and notes, including electronic aids.
- 4. Analysis/diagnostic task area for group discussions.
- 5. Supervisory task area, taking the following into consideration:



- a) Conflicting factors, such as the work organisation (team work versus hierarchical distance between operating personnel and supervisory staff).
- b) Privacy aspects.
- c) General view on the process.
- 6. Permit handling task area, with a workspace (counter) either as part of the CR or in a separate room depending on work organisation factors, such as:
 - a) Who handles permits?
 - b) How to cope with peak hours.
 - c) How to know exactly what is going on in the field.
 - d) A quiet environment in the CR.
- 7. Training area with equipment and workspace for:
 - a) Operator training purposes.
 - b) Studying (manuals, books) and learning on the job (guided by an experienced operator).
- 8. Printer area considerations:
 - a) Use of printers (long-term, diagnostic, and immediate).
 - b) Noise levels of intended equipment.
- 1. Consider space allowances in the rack rooms, electrical rooms and control room.

The single most common trait of control centres is that generally they are too small, requiring expensive additions or in the case of blast resistant designs, compromising the original design assumptions, incremental floor space is of trivial cost compared to building additions.
- m. Design and installation practices of telecommunication systems shall be in accordance with GP 59-11 and GP 59-13 as applicable.

5.2. Safety

5.2.1. General

- a. Safety of personnel shall be the prime consideration in the design of control centres and/or associated facilities.
- b. Any new design shall include safety of personnel as the first objective, and revamps to existing control centres or associated buildings shall include review of the protection provided to personnel.
- c. Safety shall include not only protection from the most significant hazard such as blast effects but also fire, exposure to vapours or dusts, falls, lack of proper storage for safety equipment, an environment which promotes fatigue, noise, and the full range of related issues.
- d. No personnel other than those necessary to man the control centre should be located within it. Since the governing premise for the design is personnel protection, minimizing personnel within the risk area is appropriate.

5.2.2. Exits

- a. Easy physical access shall be provided to evacuation routes from the CC and the CR.
- b. A minimum of three (3) exits should be considered. For blast resistant designs, there is generally no exit on the side towards the greatest blast hazard.



- c. All exits should be provided with “air lock” configurations, generally with the “air lock” enclosed within the building.

5.2.3. Emergency Lighting

- a. Control Centre emergency lighting circuits shall be fed from the emergency power supply system and/or self contained batteries.
- b. For light safety, emergency lamps should be furnished to illuminate egress from CC. These lamps should be capable of emitting 11 lux (1 foot-candle) measured at floor level.
- c. Exit lights shall be provided in accordance with applicable local codes. For North America refer to NEC article 700 and NFPA 101

5.2.4. Fire and gas detection

- a. Fire and gas detection requirements in the CC shall be in accordance with GP 30-85.
- b. In North America, for protection of data processing equipment refer to NFPA 75.
- c. Early smoke detection shall be evaluated in rooms and cabinets where early warning and manual action can serve to:
 - 1. Save equipment from severe damage.
 - 2. Avoid long plant shutdown.

Particularly in unmanned areas, the use of VESDA (very early smoke detection apparatus) equipment maybe considered, refer to GP 30-85.
- d. To prevent infiltration of gases, buildings should maintain a slight positive pressure with relation to exterior conditions.

5.2.5. Location/Blast protection

- a. A “site study” should be performed (using personnel with appropriate expertise) to determine blast risk areas within the plant.
- b. If feasible, CRs should be located outside the blast risk zone to minimise hazardous exposure.

Existing control buildings are located very near and sometimes within an operating process unit. A current industry trend is to remotely locate control buildings, at least greatly extend the physical distance between hazardous areas and normally occupied buildings.

With fibre optic technology and various communication devices, the only limitations on CR location are generally a result of desired work processes.

- c. Distance from the potential release source, ignition source, and proper location with respect to prevailing winds should be considered for new control room designs.

This is very pertinent to chemical and refinery facilities, where it is recommended to locate the control centre in the periphery of the process units, with good access to roads and upwind of any units likely to release hydrocarbon vapours, which could travel along the ground. They are generally alkylation, light end facilities, spheres and bullets. Propane, Butane, and other hydrocarbons of approximately the same molecular weight are the prime candidates to form vapour clouds. Similarly, H₂S and HF releases can travel as vapour clouds or fog.

- d. If the required proximity of a new control centre to the process is such that a hazard exists, the appropriate solution is a standard building design optimised for blast resistance or a complete blast resistant design.



There is no single blast resistant design appropriate to all situations. If a hazard scenario is developed which leads to an extraordinary (greater than 170 kPa (25 psi) overpressure) design basis, the location of the proposed structure shall be re-evaluated rather than simply proceeding with the design. Such a result implies that no reasonable structure can protect personnel, so an alternative may be to remove the building from the threat area.

- e. In blast resistant designs, double doors shall be located on a building face opposite the blast risk.

This is because double-door configurations are unlikely to survive a significant blast if directly exposed to it.

5.3. Environmental control

5.3.1. HVAC

- a. Buildings or shelters that house process-related equipment should be designed to ventilate the building. Refer to GP 14-XX for HVAC guidelines.
- b. In buildings and shelters for which no ventilation rate has been established, the quantity and rate of ventilation should be based on:
 1. CC inside design conditions.
 2. CC outside design conditions.
 3. Size and physical characteristic of the CC.
 4. Average number of occupants.
 5. Heat load from the equipment housed in the CC, including provisions for future expansion.
 6. Heat dissipation.
 7. Dilution of toxic or flammable gases.
 8. Makeup/pressurization flow rate required to maintain positive pressure on the building.

If no rate is shown, use six air changes per hour for normal conditions and 12 air changes per hour for emergency conditions.

- c. HVAC shall be capable of operating in 100% recycled air mode.

Some emergency actions require “sheltering in place” in the CR and isolating all makeup air.
- d. The HVAC system shall consider worst-case summer and winter conditions.
- e. The use of steam injection for humidity control shall be strictly prohibited.
- f. Consider energy efficiency in the selection of HVAC systems.

This should avoid inefficient re-heat type systems.

- g. Consider sufficient access for maintenance and equipment removal in the HVAC equipment area.
- h. Climate control shall be as follows:
 1. Temperature controls in each major work area.
 2. Ventilation ducts and grills placed to avoid drafts on personnel.
 3. Individual controls at each console position.

