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GUIDELINES FOR PROCESS CONTROL PROJECT ENGINEERING

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Standard and Specification provides guidelines on the engineering processes that go into completing Process Control and Instrumentation (C & I) work for clients.

INITIALISATION PHASE

User Requirements and Scope of Work

1. Scope

   Determine the client's requirements for control and instrumentation and write them up for reference during the project.

2. Input

   Discuss with the project leader and client the requirements in terms of the checklist detailed at the end of this procedure to ensure that all items relating to the User Requirements and Scope of Work are covered. The Project Brief must also be studied to ensure its requirements are covered.

3. Process

   Determine the requirements in conjunction with the client. The information should be gathered by studying the Project Brief and/or discussions with the client.
   It must then be analyzed to ensure that it is complete and consistent.
   A checklist of items to be evaluated is attached to this procedure.

4. Output

   Produce a document entitled User Requirements and Scope of Work. It is circulated to all interested parties in the project. They will respond with their comments which are to be incorporated into a revision of the document.

5. Approval

   The document must be approved by the client and the discipline Project C&I Engineer once the revisions are complete.

Checklist of User Requirements and Scope of Work

The following is a checklist of the factors to be considered:

1. Systems Required

- plant control and instrumentation
- monitoring systems
- telephone systems
- intercom systems
- radio systems
- networking for voice and data
- CCTV
- access control
- fire detection and protection
- security systems
- vehicle location/tracking/condition monitoring

2. Services Required

- feasibility study
- conceptual design
- estimating
- simulation
- design
- software
- specification
- enquiries
- orders
- installation
- site supervision commissioning

3. Timescales

- project program

4. Process Control Requirements

- type of plant: material (gold, coal, etc.); process (CIP, rail loading etc.); scale (pilot, sample, test, production)
- description of process operation
- flow sheets
- cost sensitivity of the project
- special process requirements e.g. hazardous processes, explosive and/or toxic and/or corrosive.
- level of automation required
- level of instrumentation required
- new, extended, modified, upgraded or refurbished
- production factors, e.g. productivity index, plant availability/utilisation, allowable downtime

- description of control facilities (i.e. degree of functionality in terms of logging, reporting, diagnostics, optimisation, maintenance, simulation capabilities, etc.) to be catered for now or in the future.
- number and quality of plant operators to be catered for (i.t.o. level of understanding of the process, equipment and control systems)
- plant infrastructure requirements for air, water supplies.

5. Plant Control Philosophy

- type of control system required: e.g. hardwired, PLC, distributed control system, supervisory system
- degree of centralisation/de-centralisation
- plant geographical layout and control nodes
- control system architecture
- connection to management level systems
- local/remote control of machines or processes
- connection to other plants, areas or systems
- system response times
- reliability
- intellectual property rights

6. Equipment and Design Requirements

- standardisation/conformity with existing systems/equipment
- equipment preferences non-preferences
- compatibility with existing equipment
- fire retardancy of cables
- client preferences for specifications
- preferred design standards, drawing symbols and numbering systems

7. Spare Capacity Requirements

- possibility of future extensions (plant areas and/or streams) and to what extent it must be allowed for in the design
- supervisory system expansion
- plc expansion
- tags, database
- control cubicle expansion
- additional instrumentation
- spare space requirements (i.e. instrument rooms, cable racks, etc.)
- spares policy, commissioning and maintenance (project, client supply)

8. Safety Requirements

- hazardous areas and classification
- personnel and equipment protection circuitry

- earth fault/leakage limitation requirements
- security/entry restriction requirements
- fire protection requirements (cables, seals)

9. Environmental Considerations

- environmental sensitivity of project
- altitude
- ambient temperature range
- humidity
- corrosion, in air/water/ground
- lightning activity
- pollution, dust

10. Power Source (Liaise with Electrical Engineer)

- reliability of power supply
- stability or quality of power supply (voltage, frequency, harmonics)
- interruptions to raw mains supply - frequency and duration
- provision of clean, secure supplies, e.g. UPS, CVT
- required duration of back-up supplies for instrumentation and computer systems
- lightning/surge protection practice
- earthing requirements

11. Local Infrastructure

- availability of skilled manpower
- availability of locally manufactured equipment
- availability of spare parts
- availability of communication infrastructure
- availability of suppliers and contractors
- need for special work permits, security clearances - central, regional and local government requirements
- applicable standards and authorities

12. Control and Instrumentation Room Requirements

- number of occupants and facilities
- temperature requirements
- humidity
- ventilation and air filtering requireme
- vibration
- static control
- cable management e.g. ducts, raised floor
- lighting

13. Quality Assurance Requirements
    - QA philosophy
    - identification of critical equipment
    - plant life expectancy
14. Site Layout and General Arrangement Drawings
    - obtain copies of above diagrams, if available
15. Training and System Development Requirements for Operating and Maintenance Staff
    - services required
    - nature of facilities required
    - simulation needs

CONCEPTUAL ENGINEERING

Conceptual Design

1. Scope

   The Conceptual Design gathers sufficient information on the job to allow it to be cost and planned. Develop alternative designs.

2. Input

   The User Requirements and Scope of Work, Block plan and Flow sheets are used to do the conceptual design.

3. Process

   The input documents are analyzed to yield information on the following:
   - control system configuration
   - number and size of the control nodes
   - types and number of instruments
   - instrumentation and control equipment geographical layout.

4. Outputs

   In order to provide estimates for the project the following documents are to be produced:
   - preliminary instrument schedule
   - preliminary I/O schedule
   - preliminary Control System Architecture Block Plan

5. Approval

The Project C&I Engineer is to approve the documents.

Design Scope

1. Scope

   The design scope defines the work to be done by the C & I Department for the client and the documents that will be produced.

2. Inputs

   The inputs are the User Requirements and Scope of Work, and the Conceptual Design. Hold meetings with the client and Project leader to discuss the requirements.

3. Process

   Once the scope of work is known, the C & I engineer can make proposals on what services are to be included and how the work is to be done.
   Where the client prefers to do portions of the work or wants to be involved in, or approve, certain portions of the work it is advisable to draw up a responsibility schedule. The responsibility schedule defines which deliverables are to be produced by the various parties.

4. Outputs

   The Design Scope will define the specific services to be provided and a list of the output documents (or deliverables) that will be produced.
   Services to be provided may include:
   - Plant Simulation
   - Engineering
   - Enquiries, Adjudication and Orders
   - Design
   - Software
   - Operator Training
   - Site Supervision
   - Commissioning

   Output Documents may include:

   - User Requirements and Scope of Work
   - Preliminary Design
   - Design Scope
   - Class I Capital Budget and Reimbursable Estimate
   - Basic Project Requirements for C & I Design, comprising a compilation of the above documents
   - Conceptual Design

- Class II Budget
- Specifications
- Detail Design Drawings
- Functional Specification
- Software Documentation
- Enquiries and Adjudications
- Class III Budget
- Progress Reports
- Class IV Budget
- As Built Documents
- Close Out Report

5. Approvals

   The Design Scope needs the approval of the Project CIE Engineer, who will discuss the document with the CIE Manager before it is submitted for client approval.

Class I Estimates and Budgets

1. Scope

   Approximate costs for the proposed C & I work are required early in the project. Class I estimates are the lowest level of accuracy produced for projects. They are "Order of Magnitude" estimates where the target accuracy is dependent on the data available. The range of accuracy is to be indicated on the estimate. Refer to the Project procedures for the detailed definition of Class I estimates.

2. Inputs

   The Conceptual Design gives the capital items to be purchased. The Design Scope document details the work to be done.

3. Process

   Capital Equipment costs are estimated by obtaining current budgetary quotes and comparing with actual costs, suitably escalated from past projects. The C & I costs must be checked against the total capital value of the project.
   Standard rates for design drawings multiplied by the number of drawings required allows the design reimbursable budget to be calculated. Similarly the engineering and software work needs to be estimated and hours put to the work. Once this is done it must be compared with actual hours used on similar past projects. The cost of the reimbursable hours needs to be checked as a percentage of the capital value of the C & I costs.

4. Outputs

   Standard estimate sheets are available for reimbursable man-hours and capital costs. These are completed, showing the work to be done, the level of accuracy and the associated costs.

5. Approvals

   It is essential that the reimbursable estimates for all large projects are signed by the Manager in addition to the Project C&I Engineer. Capital cost estimates will be discussed by the Project C&I Engineer with the CIE Manager.

Program

1. Scope

   A provisional program of work is drawn up to ensure that the C & I work can be scheduled within the time-scales required by the client.

2. Inputs

   The number of reimbursable hours has been determined in the Class I estimate. The project plan will give the approximate time-scales available to do the work and the list of required deliverables.

3. Process

   Discussions with the planner around the above documents allow the C & I work to be scheduled. The C & I Engineer will then estimate how many people will be required and when they will be needed. This will allow a program of work to be defined in conjunction with the project planner. The impact on the department must be considered.
   The program must show all the project phases including capital equipment phasing to ensure that the work can be done within the required time-scales. The work breakdown should be shown in terms of the deliverables to be produced.
   Different levels of detail are normally needed (Level 1, 2, 3) to suit the requirements of the overall project program.

4. Output

   This work is done in conjunction with the Project Planner and the final output is generated by him. It remains the responsibility of the discipline engineer to ensure the accuracy of his portion of the work.