U. S. Army Corps of Engineers Process Instrument And Control Checklist

Installation Name	_____
Site Name / I.D.	_____
Evaluation Team	_____
Site Visit Date	_____

This checklist is designed to facilitate the performance evaluation of process instrumentation and control systems used to operate and monitor treatment processes and equipment. It is divided into the following sections:

1) Evaluation team composition
2) Typical objectives
3) References
4) Survey of instrumentation and controls
5) Operation and maintenance programs
6) Typical performance problems
7) Process monitoring
8) Alternatives for possible cost savings
9) Supplemental notes and data.

The checklist provides suggestions for information gathering, and space has been provided to record data and notes from the site visit. Supplementary notes, if required, should be numbered to correspond to the appropriate checklist sections.

1) Evaluation Team Composition

The following disciplines should be included in the evaluation team for the instrumentation and control system.

- Instrument Engineer (site visit, control system evaluation)
- Process Engineer (site visit)
- Cost Engineer (cost of alternatives)

2) Typical Objectives

Verify that the objectives established when the instrumentation and control system was designed and installed are clear and still valid.

3) References

Coordinate this checklist with the applicable treatment process checklist(s). The following references may also be helpful:

CEGS 13405 [1]: Process Control
NIST SP 250 (1995): Calibration Service Users Guide
NFPA 70: National Electrical Code
ETL 1110-3-492 Year 2000 (Y2K) Compliance and Acceptance Procedures
USACE guidance on microprocessor year 2000 (Y 2K) compliance can be found at http://www.usace.army.mil/inet/functions/im/ceimp/y2kguide.html.
Technical help on microprocessor year 2000 (Y 2K) compliance can be found at http://www.zdnet.com/zdy2k/.

4) Survey of Instrumentation and Controls

Use the following checklists and tables to identify which instruments and control equipment are currently used.

4.1) Sensors

a) Check all sensors that are used.

- ❑ run time meter
- ❑ watt-hour meter
- ❑ leak detection
- ❑ level instrumentation
- ❑ differential pressure switch
- ❑ flow switch
- ❑ temperature sensor
- ❑ pressure sensor
- ❑ gas flow
- ❑ liquid flow
- ❑ gas velocity
- ❑ liquid velocity
- ❑ calorimeter (fuel value)
- ❑ combustible gas
- ❑ conductivity
- ❑ oxidation reduction (ORP)
- ❑ pH
- ❑ photoionization (PID)
- ❑ total dissolved solids (TDS)
- ❑ turbidity
- ❑ water hardness
- ❑ ammonia (NH_3)
- ❑ carbon dioxide (CO_2)
- ❑ carbon monoxide (CO)
- ❑ chlorine (Cl_2)
- ❑ hydrogen sulfide (H_2S)
- ❑ nitrogen oxides (NOx)
- ❑ oxygen (O_2)
- ❑ ozone (O_3)
- ❑ dissolved ammonia
- ❑ dissolved oxygen
- ❑ dissolved ozone
- ❑ dissolved chlorine
- ❑ other: _____
- ❑ other: _____
- ❑ other: _____

b) Have any of the sensors been repaired or replaced? If yes, which ones?

_____
_____

4.2) Control Systems

Check the type of control system in used.

a) The system is:

- ❑ manual on-off
- ❑ with alarm override
- ❑ with feedback trim from _____
- ❑ semi-automatic on-off
- ❑ flow proportional
- ❑ Other:_____

b) The Control is:

- ❑ direct digital control (DDC)
- ❑ distributed
- ❑ loop
- ❑ programmable logic control (PLC)
- ❑ modular
- ❑ other:_____

c) The system is connected by:
❑ 4-20 mA control wiring ❑ 10-50 VDC control wiring
❑ instrument air & pneumatic tubing ❑ other:_____

d) Has the control system required any major modifications or repairs? If yes, what was modified or repaired?
_____
_____

e) Have the hardware and software been checked for year 2000 (y2k) compliance? No / Yes
Description _____
_____

Remarks _____
_____

5) Operations and Maintenance Programs

a) Tools and Equipment

Are the following items in-stock in sufficient numbers and accessible?

	Adequate Stock?		Accessible?		Remarks
	Yes	No	Yes	No	
Calibration devices					
Consumable supplies					
Special tools					
Portable tester/workstation					

b) Maintenance Programs and Procedures

Are each of the following programs/procedures in-place and well-documented?

Diagnostics	In place?	Adequately Documented?	Remarks
	Yes	No	
Preventive maintenance procedures and schedules			
Communication and programming			
Device troubleshooting and diagnostic procedures			
Repair instructions			

c) Operation of the control system

Discuss the following items with the operator:

Discussion Item	Remarks
Sequence and control loops	
Set-points	
Control ranges	
Selector switches	
Push buttons	
Other inputs	
Failures/upsets	
Chart recorders	
Event recorders	

d) Are the control panels located to optimize operation and maintenance activities? What is the general condition of the control panels? (e.g., complete, disassembled for repair)

_____
_____

6) Typical Problems

a) Is there evidence of feedback loop instability? (e.g., Cycling, sine waves in the printouts, surging)

_____
_____

b) Is the influent concentration too low to measure accurately with the instrumentation?

_____
_____

c) Are the sensor operating range(s) oversized, undersized, or appropriate? What are the typical readings as a percent of full scale?

_____
_____

d) Is there adequate straight pipe/channel distance upstream and downstream of instruments for accurate measurement? Are the straight pipe/channel distances in accordance with the manufacturer's recommendations?

_____
_____

e) Are the flow meter operating ranges oversized, undersized, or appropriate? What are the typical readings as a percent of full scale?

_____
_____

f) Are the pressure gauge operating ranges oversized, undersized, or appropriate? What are the typical readings as a percent of full scale?

_____
_____

g) Is the construction documentation clear and updated to the existing conditions? (e.g., piping and instrumentation drawings (P&ID), manufacturer's descriptive and technical literature, performance charts, installation instructions)

_____

h) Are the operating instructions and the maintenance manual clear and updated to existing conditions?

_____
_____

i) Is the nameplate data complete on each piece of equipment?

_____
_____

j) Are the instrument and valve tags complete and consistent with the controls and the P&ID?

_____
_____

k) Are there suitable interlocks on major equipment?

_____
_____

l) Are all control signals, pneumatic tubing, and wiring compatible between interconnected subsystems and the central control system?

_____
_____

m) Has an electrical inspector verified that all NFPA 70 classifications are accurate and that the wiring is appropriate for the area classification in which it is installed?

_____
_____

7) Process Monitoring

a) What control reports are generated?

_____
_____

b) Are instrument calibrations performed in-house or by a contractor? Are the calibration procedures accessible and clearly outlined?

_____
_____

c) Instrument calibration:

Instrument ID	Calibration Frequency	Date of Last Calibration	Remarks
		__/__/__	
		__/__/__	
		__/__/__	
		__/__/__	

d) Are all calibration gases/solutions traceable to NIST?

_____
_____

e) Are all of the calibration gases/solutions fresh? List the expiration date(s).

_____
_____

f) Instrument testing

	Device	Last Test Date	Results
Analog alarms		____/____/____	
Digital alarms		____/____/____	
Alarm horns		____/____/____	
Pulse accumulator alarms		____/____/____	
Alarm settings		____/____/____	
Auto dialer		____/____/____	
Panel indicator lights		____/____/____	
Interlock		____/____/____	
Uninterruptable Power Supply (UPS)		____/____/____	

8) Alternatives for Possible Cost Savings

a) Is the degree of automation appropriate?

_____
_____

b) Is there more potential for unattended/remote operation?

_____
_____

c) Would a reduction/simplification in instrumentation reduce the O&M without compromising the treatment system?

_____

_____

d) Is all of the data that is being collected needed for required reports? Verify the requirements for the data generated and eliminate/reduce redundant reports.

_____

_____

9) Supplemental Notes and Data

There are _____ pages of supplemental notes and data attached to this checklist.

1 CEGS: USACE Guide Specifications for Construction, available at www.usace.army.mil/inet/usace-docs/