

The Economic Advantages of Field Networks*

Labor Costs

The utilization of an industrial communications field network will greatly contribute to the overall reduction of labor costs as compared to a conventional hardwired scheme where individual wires must be pulled through a protective conduit that is hundreds of feet long.

Hardwired 180 valve system \$223,905
Networked 180 valve system \$102,120



Engineering/Design Costs

Automated valves and process sensors are simply connected to the network at the points along the path where they are located. A total engineering/design savings of over 5 hours per valve can be realized.

Hardwired 180 valve system \$116,460
Networked 180 valve system \$51,120



Material Costs

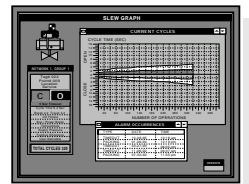
The amount of conduit, fittings, wire, and junction housings is greatly reduced. When compared with conventional systems, field networks eliminate a substantial amount of field wiring and the labor necessary to install it.

Hardwired 180 valve system \$228,404
Networked 180 valve system \$182,355



Maintenance Costs

Field networks create the foundation for a plant wide valve management system that takes full responsibility for monitoring and diagnosing valve performance from start-up to predictive/preventive maintenance scheduling.



*A detailed cost analysis for each field network can be found on the following pages:

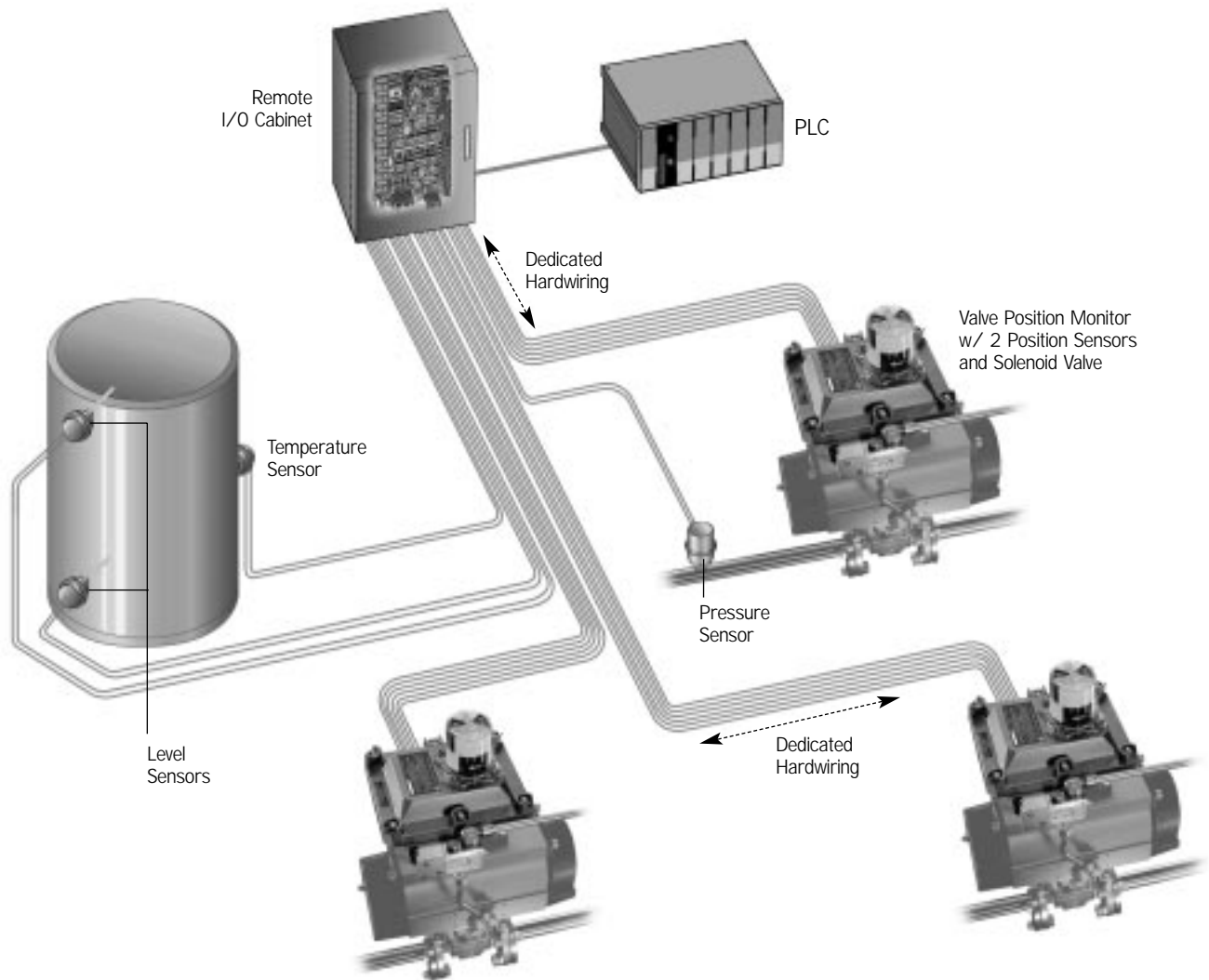
Cost Overview 2-3
 Modbus 4-7
 A-B DeviceNet 8-11
 AS-interface 12-15

WESTLOCK
 Network Systems Group

System Comparisons

Typical Hardwired System

Conventional wiring systems generally require that individual control wires run from the I/O cabinet to the position sensors and solenoid of each automated valve. For systems consisting of a multitude of pneumatically actuated on-off valves, hundreds of wires must be run and properly connected — not only to each position sensor and solenoid valve, but also back to the proper point of connection at the I/O cabinet.

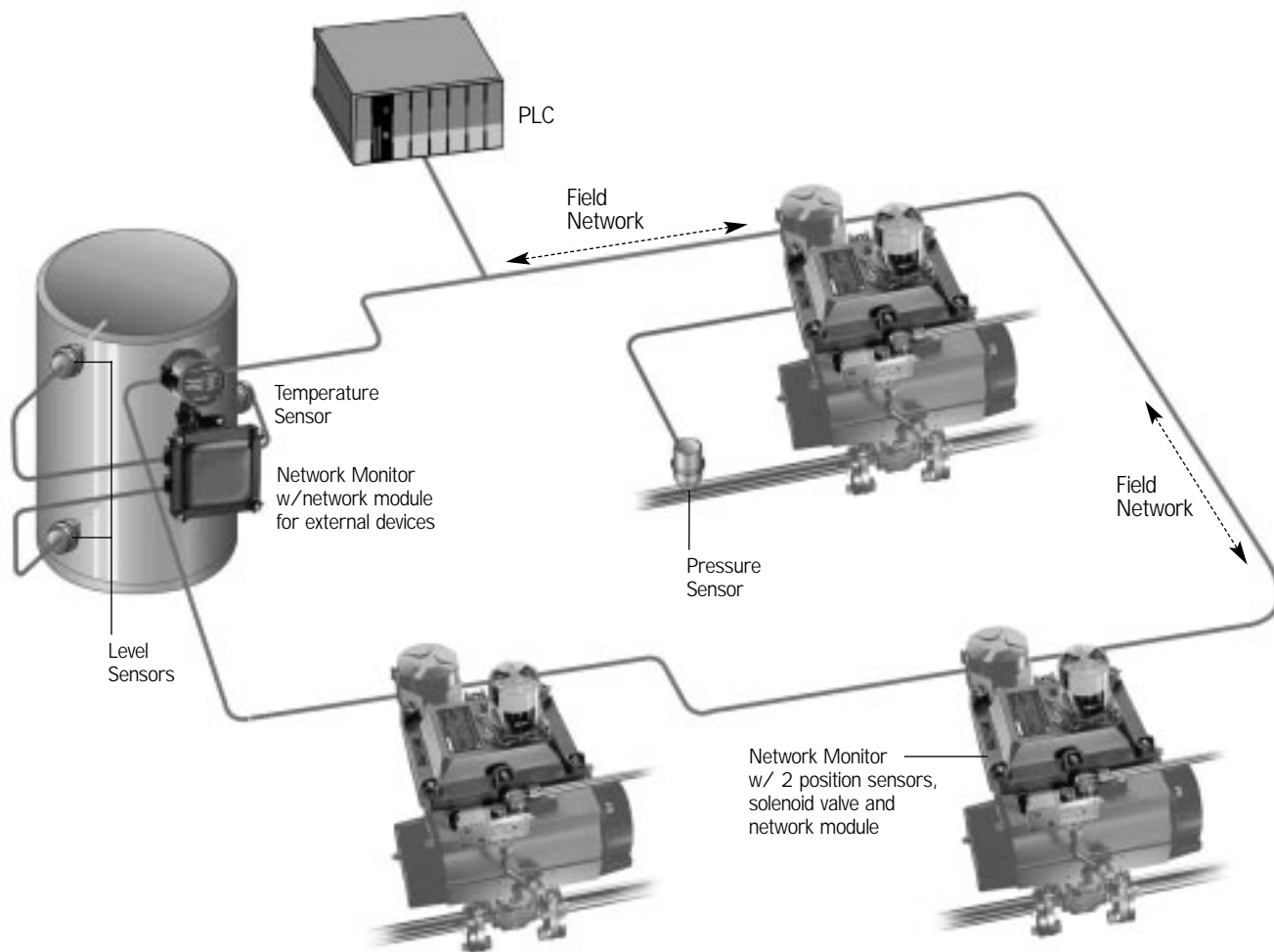


HARDWIRED SYSTEM COST (180 Valve System)	Labor & Material Cost	\$452,309	\$838 Per I/O Point
	Engineering/Design Cost	\$116,460	\$216 Per I/O Point
	TOTAL COST	\$568,769	\$1,054 Per I/O Pt

A detailed cost analysis for each field network can be found on the following pages: ModBus 4-7 • DeviceNet 8-11 • AS-interface 12-15

INTELLIS® Network System

By integrating a network module within the Westlock Network Monitor, pneumatically actuated on-off valves and external devices are simply connected to the field network at the points along the path where they are located. The need for remote I/O cabinets and thousands of feet of dedicated control wiring from each automated valve and external sensor is eliminated.



INTELLIS SYSTEM COST (180 Valve System)	Labor & Material Cost	\$284,484	\$526 Per I/O Point
	Engineering/Design Cost	\$51,120	\$94 Per I/O Point
	TOTAL COST	\$335,604	\$620 Per I/O Pt

A detailed cost analysis for each field network can be found on the following pages: ModBus 4-7 • DeviceNet 8-11 • AS-interface 12-15

ModBus®

Cost Analysis



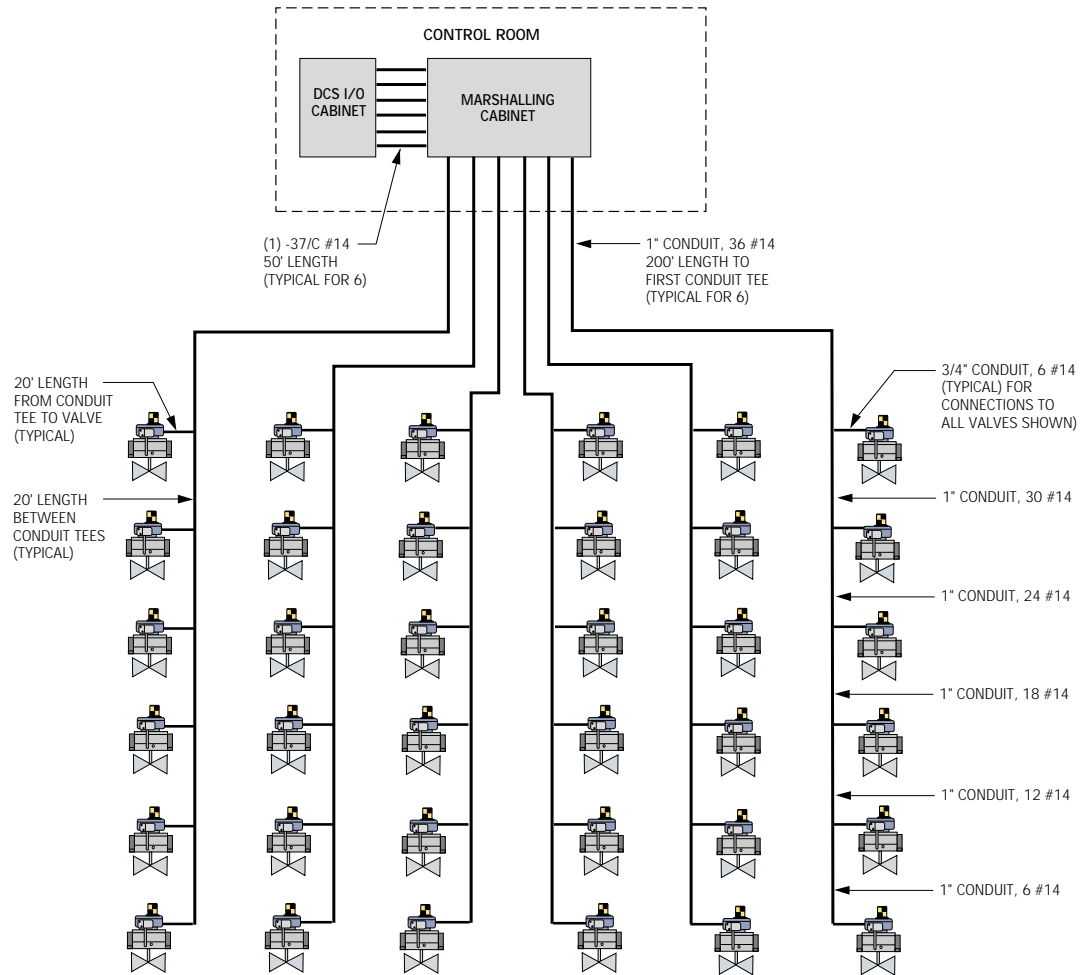
CONVENTIONAL SYSTEM

DCS with Central I/O

This sketch is typical for 5 field networks. (36 valves per network, 180 valves per system)

NOTES:

1. All valves shown are pneumatic actuated on/off type, with 3-way solenoid and open/close position sensors.
2. All conduit is above ground, rigid galvanized steel.
3. All #14 wiring is type THHN insulation



CONVENTIONAL SYSTEM (DCS with Central I/O)

MATERIAL DESCRIPTION	TAKEOFF QUANTITY		INSTALLATION LABOR				MATERIAL		TOTAL L&M COST
	AMOUNT	UNIT	PER UNIT	TOTAL HOURS	MH RATE	LABOR COST	COST/UNIT	MATERIAL COST	
3/4" Conduit	5400	feet	0.1	540.0	50	27,000	0.95	5,130	\$32,130
1" Conduit	7200	feet	0.1	720.0	50	36,000	1.39	10,008	\$46,008
Conduit Fittings & Supports	allowance	lot	-	960.0	50	48,000		14,600	\$62,600
#14 Wire	300000	feet	0.006	1,800.0	50	90,000	0.06	18,000	\$108,000
37/C #14 Multiconductor Cable	1800	feet	0.04	72.0	50	3,600	1.25	2,250	\$5,850
#16 Twisted Pair, Shielded	0	feet	0.007	-	50	-	0.15	-	-
RS-232 Cabling	0	feet	0.008	-	50	-	0.75	-	-
Terminations	4320	each	0.08	345.6	50	17,280	0.05	216	\$17,496
Valve Solenoid & Position Sensors	180	each	0	-	50	-	450	81,000	\$81,000
Intellis Network Interf. Mgr. & PC	0	each	0	-	50	-	7500	-	-
Marshalling Cabinet	540	each	0.075	40.5	50	2,025	80	43,200	\$45,225
Input/Output Hardware	540	per I/O point	0	-	50	-	100	54,000	\$54,000
TOTALS				4,478.1		\$223,905		\$228,404	\$452,309

ModBus® Cost Analysis



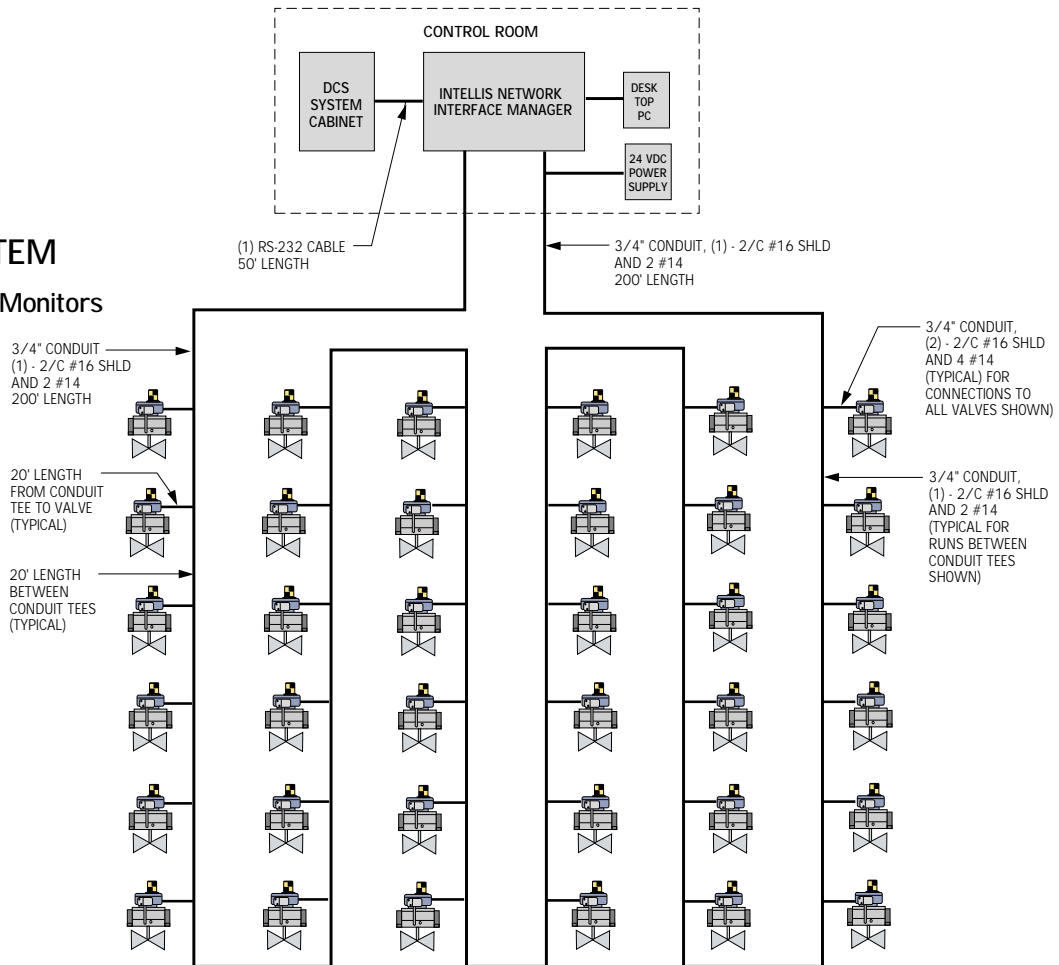
INTELLIS® MODBUS SYSTEM

DCS with Network Monitors

This sketch is typical for 5 field networks. (36 valves per network, 180 valves per system)

NOTES:

1. All valves shown are pneumatic actuated on/off type, with 3-way solenoid and open/close position sensors.
2. All conduit is above ground, rigid galvanized steel.
3. All #14 wiring is type THHN insulation



INTELLIS SYSTEM (DCS with Network Monitors)

MATERIAL DESCRIPTION	TAKEOFF QUANTITY		INSTALLATION LABOR				MATERIAL		TOTAL L&M COST
	AMOUNT	UNIT	PER UNIT	TOTAL HOURS	MH RATE	LABOR COST	COST/UNIT	MATERIAL COST	
3/4" Conduit	9200	feet	0.1	920.0	50	46,000	0.95	8,740	\$54,740
1" Conduit	0	feet	0.1	-	50	-	1.39	-	-
Conduit Fittings & Supports	allowance	lot	-	736.0	50	36,800		8,770	\$45,570
#14 Wire	25400	feet	0.006	152.4	50	7,620	0.06	1,524	\$9,144
37/C #14 Multiconductor Cable	0	feet	0.04	-	50	-	1.25	-	-
#16 Twisted Pair, Shielded	12700	feet	0.007	88.9	50	4,445	0.15	1,905	\$6,350
RS-232 Cabling	60	feet	0.008	0.5	50	24	0.75	45	\$69
Terminations	1810	each	0.08	144.8	50	7,240	0.05	91	\$7,331
Network Monitors	180	each	0	-	50	-	846	152,280	\$152,280
Intellis Network Interf. Mgr. & PC	1	each	0	-	50	-	9000	9000	\$9,000
Marshalling Cabinet	0	each	0.075	-	50	-	80	-	-
Input/Output Hardware	0	per I/O point	0	-	50	-	100	-	-
TOTALS				2,042.6		\$102,129		\$182,355	\$284,484

ModBus®

Cost Analysis



ENGINEERING/ DESIGN COSTS

Conventional System vs INTELLIS® with Modbus

The following tabulations are on a per valve basis for engineering and design activities normally associated with ON/OFF valves on a process industry capital project.

A total engineering/design savings of over **5 hours per valve** can be realized. On a project with 180 ON/OFF valves and an engineering billing rate of \$70/hr, savings would exceed **\$65,340**. A schedule **savings of 936 man-hours** would also be achieved.

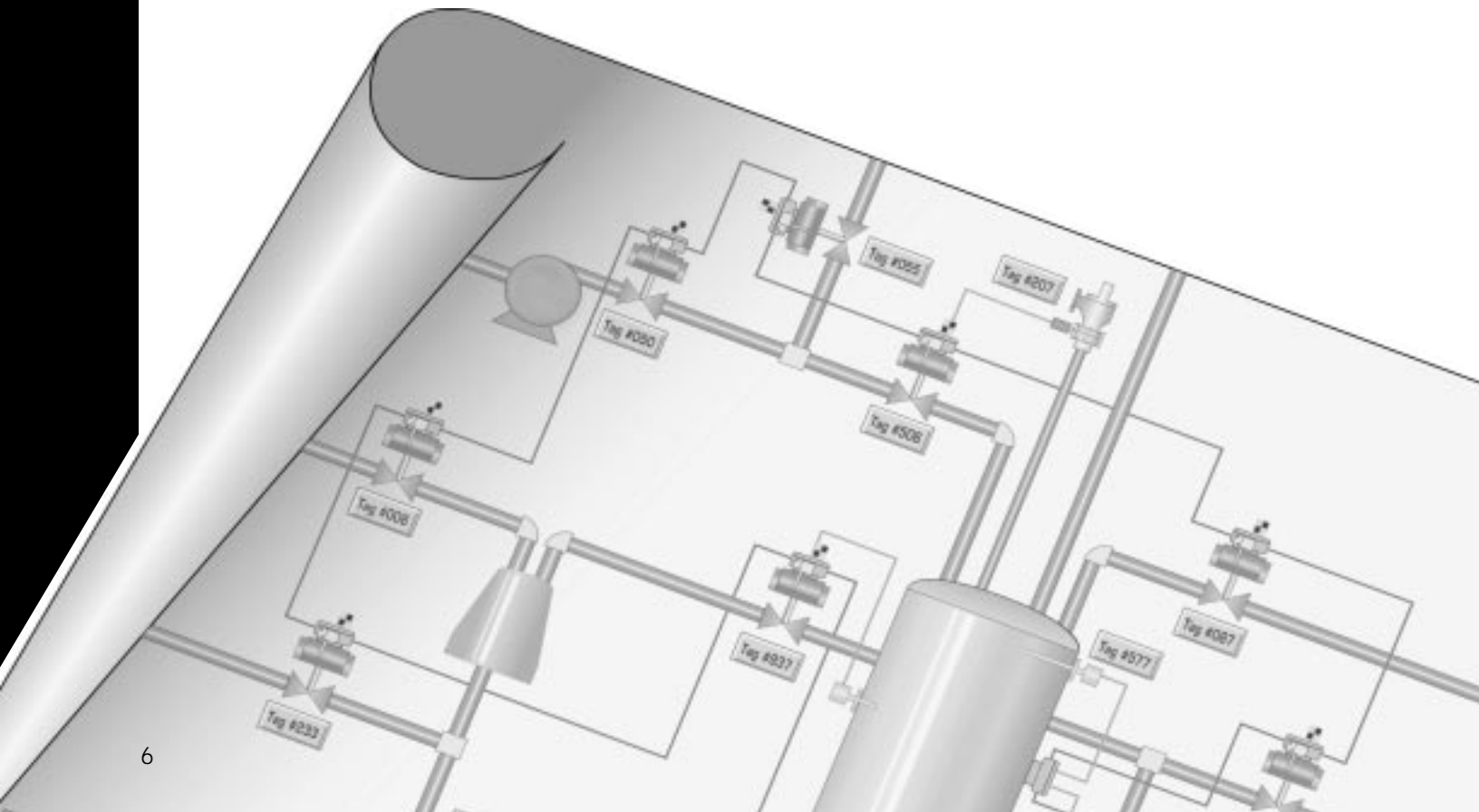
ENGINEERING/DESIGN ACTIVITY	CONVENTIONAL ON/OFF VALVE	INTELLIS Network Monitors
P & ID Development/Production	0.1 hrs	0.1 hrs
Instrument Index Development/Production	0.5 hrs	0.5 hrs
I/O Address Assignments	0.3 hrs	0.1 hrs
I/O List Development/Production	1.5 hrs	0.5 hrs
Instrument Loop Diagram Design/Documentation	4 hrs	2 hrs
Marshalling Panel Design/Documentation	0.3 hrs	0 hrs
Field Terminal Box Design/Documentation	0.3 hrs	0.1 hrs
Electrical Cabling and Termination Lists.	2.25 hrs	0.75 hrs
Total Hours	9.25	4.05
Cost per Valve \$70/hr engineering billing rate	\$647.00	\$284.00

Savings per Valve = \$363.00

Savings per I/O Point (3 I/O per valve) = \$121.00

Total Engineering & Design Savings for 180 on/off valves = \$65,340

Total Schedule Savings = 936 Manhours



ModBus®

Cost Analysis



▶ **COMPARATIVE
COST ANALYSIS
SUMMARY**

Conventional I/O System
vs Intellis® with ModBus

The following is an abbreviated cost summary of the Distributed Control System wiring scheme example outlined on the previous pages. Each example utilized a total of 180 pneumatically actuated on/off valves with 3-way solenoid and open/close position sensors. The entire system called for a total of 540 I/O points (3 per valve).

CONVENTIONAL SYSTEM

Labor & Material Cost	\$452,309	
Cost per I/O Point		\$838
Engineering/Design Cost	\$116,460	
Cost per I/O Point		\$216
TOTAL COST	\$568,769	\$1,054/I/O pt

INTELLIS SYSTEM

Labor & Material Cost	\$284,484	
Cost per I/O Point		\$526
Engineering/Design Cost	\$51,120	
Cost per I/O Point		\$94
TOTAL COST	\$335,604	\$620/I/O pt

INTELLIS System Total Savings = \$233,165

Savings per Valve = \$1,302

DeviceNet®

Cost Analysis



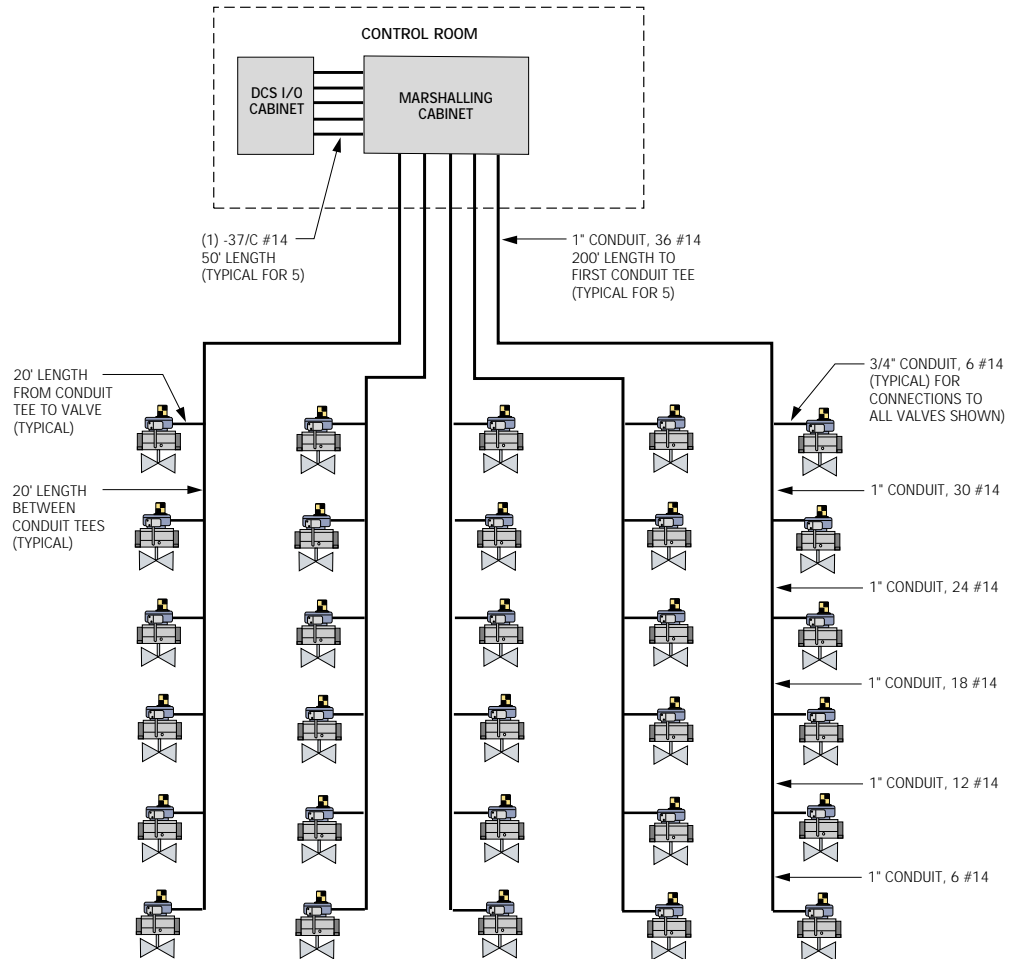
CONVENTIONAL SYSTEM

DCS with Central I/O

This sketch is typical for 4 field networks. (30 valves per network, 120 valves per system)

NOTES:

1. All valves shown are pneumatic actuated on/off type, with 3-way solenoid and open/close position sensors.
2. All conduit is above ground, rigid galvanized steel.
3. All #14 wiring is type THHN insulation



CONVENTIONAL SYSTEM (DCS with Central I/O)

MATERIAL DESCRIPTION	TAKEOFF QUANTITY		INSTALLATION LABOR				MATERIAL		TOTAL L&M COST
	AMOUNT	UNIT	PER UNIT	TOTAL HOURS	MH RATE	LABOR COST	COST/UNIT	MATERIAL COST	
3/4" Conduit	3600	feet	0.1	360.0	50	18,000	0.95	3,420	\$21,420
1" Conduit	4800	feet	0.1	480.0	50	24,000	1.39	6,672	\$30,672
Conduit Fittings & Supports	allowance	lot		672.0	50	33,600		14,600	\$48,200
#14 Wire	194400	feet	0.006	1,166.4	50	58,320	0.06	11,664	\$69,984
37/C #14 Multiconductor Cable	1000	feet	0.04	40.0	50	2,000	1.25	1,250	\$3,250
RS-232 Cabling	0	feet	0.008	-	50	-	0.75		
Terminations	2920	each	0.08	233.6	50	11,680	0.05	146	\$11,826
Valve Solenoid & Position Sensors	120	each	0	-	50	-	450	54,000	\$54,000
PLC with DeviceNet Scanner	0	each	0	-	50	-	0	-	
Marshalling Cabinet	360	each	0.075	27.0	50	1,350	80	28,800	\$30,150
Input/Output Hardware	360	per I/O point	0	-	50	-	100	36,000	\$36,000
TOTALS				2,979.0		\$148,950		\$156,552	\$305,502

DeviceNet® Cost Analysis



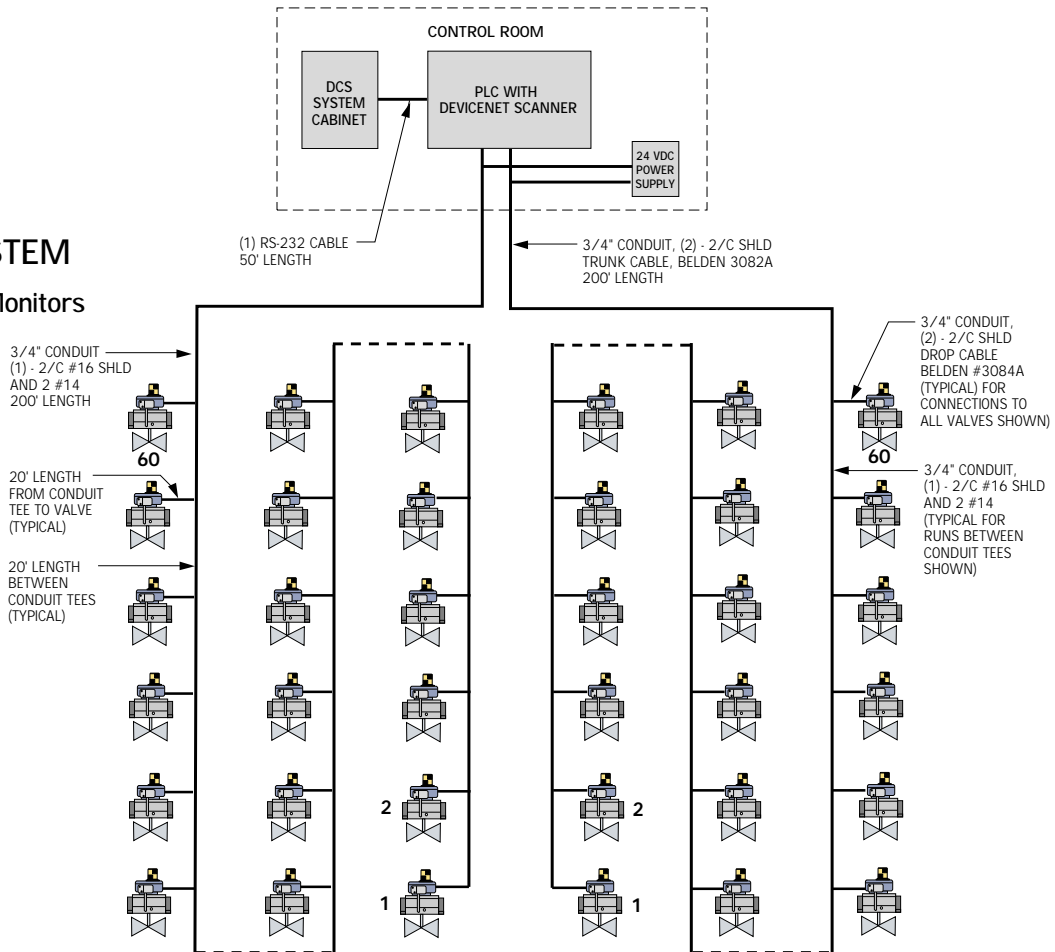
INTELLIS DEVICENET SYSTEM

DCS with Network Monitors

This sketch is typical for 2 field networks. (60 valves per network, 120 valves per system)

NOTES:

1. All valves shown are pneumatic actuated on/off type, with 3-way solenoid and open/close position sensors.
2. All conduit is above ground, rigid galvanized steel.
3. All #14 wiring is type THHN insulation



INTELLIS SYSTEM (DCS with DeviceNet Network Monitors)

MATERIAL DESCRIPTION	TAKEOFF QUANTITY		INSTALLATION LABOR				MATERIAL		TOTAL L&M COST
	AMOUNT	UNIT	PER UNIT	TOTAL HOURS	MH RATE	LABOR COST	COST/UNIT	MATERIAL COST	
3/4" Conduit	5160	feet	0.1	516.00	50	25,800	0.95	4,902	\$30,702
1" Conduit	0	feet	0.1	-	50	-	1.39	-	-
Conduit Fittings & Supports	allowance	lot	-	412.8	50	20,640	-	8,770	\$29,410
#14 Wire	0	feet	0.006	-	50	-	0.06	-	-
37/C #14 Multiconductor Cable	0	feet	0.04	-	50	-	1.25	-	-
DeviceNet Trunk Cable	2760	feet	0.007	19.3	50	966	1.2	3,312	\$4,278
DeviceNet Drop Cable	2400	feet	0.007	16.8	50	840	0.7	1,680	\$2,520
RS-232 Cabling	60	feet	0.008	0.5	50	24	0.75	45	\$69
Terminations	1440	each	0.08	115.2	50	5,760	0.05	72	\$5,832
Field Terminal Box	0	per t. block	0.08	-	50	-	0	-	-
Network Monitors	120	each	0	-	50	-	846	101,520	\$101,520
PLC with DeviceNet Scanner	1	each	-	-	-	-	-	10,000	\$10,000
Marshalling Cabinet	0	each	0.075	-	50	-	80	-	-
Input/Output Hardware	0	per I/O point	0	-	50	-	100	-	-
TOTALS				1,080.6		\$54,030		\$130,301	\$184,331

DeviceNet®

Cost Analysis



ENGINEERING/ DESIGN COSTS

Conventional System vs INTELLIS® with DeviceNet

The following tabulations are on a per valve basis for engineering and design activities normally associated with ON/OFF valves on a process industry capital project.

A total engineering/design savings of over **5 hours per valve** can be realized. On a project with 120 ON/OFF valves and an engineering billing rate of \$70/hr, savings would exceed **\$43,560**. A schedule **savings of 624 man-hours** would also be achieved.

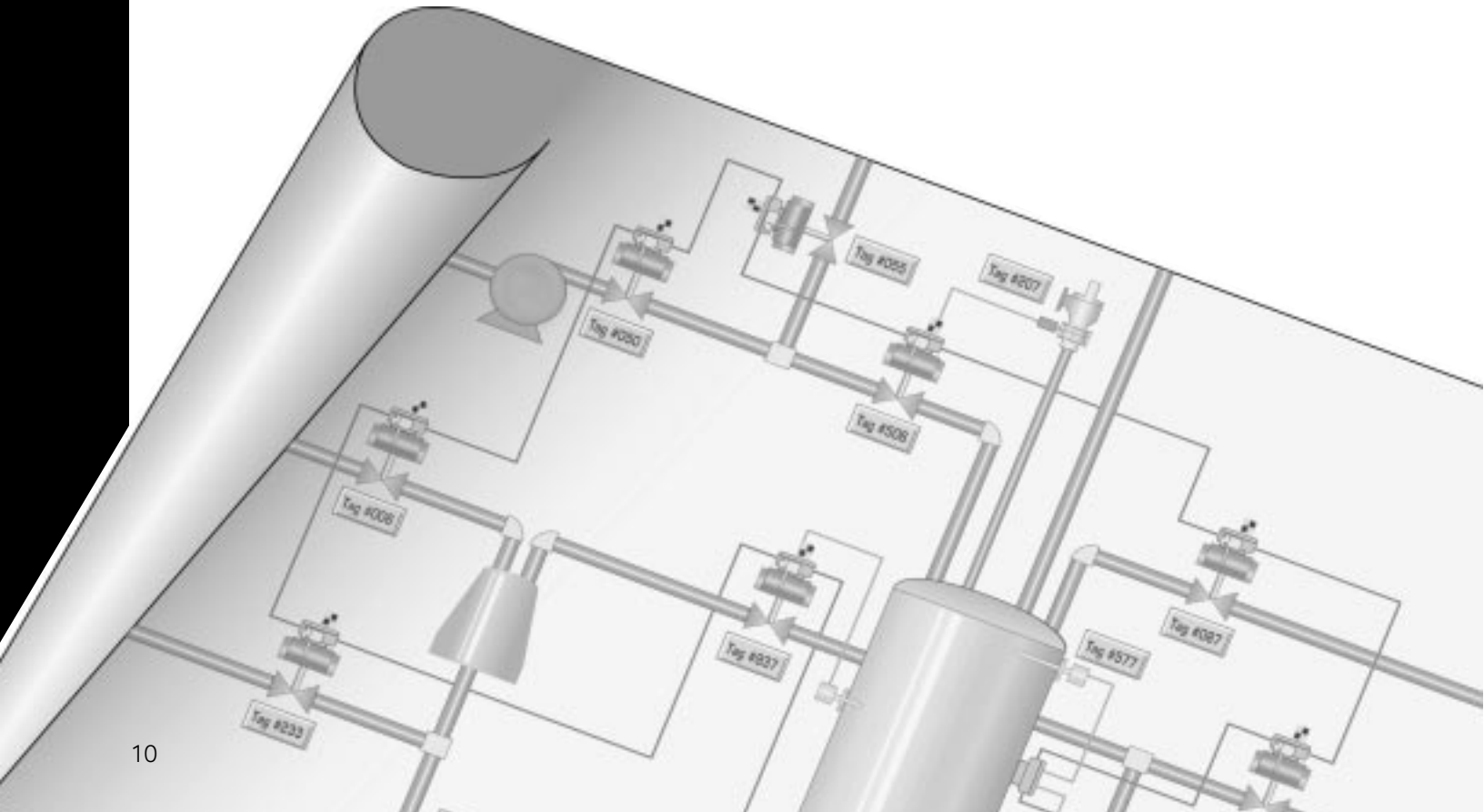
ENGINEERING/DESIGN ACTIVITY	CONVENTIONAL ON/OFF VALVE	INTELLIS Network Monitors
P & ID Development/Production	0.1 hrs	0.1 hrs
Instrument Index Development/Production	0.5 hrs	0.5 hrs
I/O Address Assignments	0.3 hrs	0.1 hrs
I/O List Development/Production	1.5 hrs	0.5 hrs
Instrument Loop Diagram Design/Documentation	4 hrs	2 hrs
Marshalling Panel Design/Documentation	0.3 hrs	0 hrs
Field Terminal Box Design/Documentation	0.3 hrs	0.1 hrs
Electrical Cabling and Termination Lists.	2.25 hrs	0.75 hrs
Total Hours	9.25	4.05
Cost per Valve \$70/hr engineering billing rate	\$647.00	\$284.00

Savings per Valve = \$363.00

Savings per I/O Point (3 I/O per valve) = \$121.00

Total Engineering & Design Savings for 120 on/off valves = \$43,560

Total Schedule Savings = 624 Manhours



DeviceNet®

Cost Analysis



COMPARATIVE COST ANALYSIS SUMMARY

Conventional I/O System
vs INTELLIS® with DeviceNet

The following is an abbreviated cost summary of the Distributed Control System wiring scheme example outlined on the previous pages. The example utilizes a total of 120 pneumatically actuated on/off valves with 3-way solenoid and open/close position sensors. The entire system calls for a total of 360 I/O points (3 per valve).

CONVENTIONAL SYSTEM

Labor & Material Cost	\$305,502	
Cost per I/O Point		\$848
Engineering/Design Cost	\$77,640	
Cost per I/O Point		\$216
TOTAL COST	\$383,142	\$1,064/I/O pt

INTELLIS SYSTEM

Labor & Material Cost	\$184,331	
Cost per I/O Point		\$512
Engineering/Design Cost	\$34,080	
Cost per I/O Point		\$94
TOTAL COST	\$218,411	\$606/I/O pt

INTELLIS System Total Savings = \$164,731

Savings per Valve = \$1,372

AS-interface® Ver. 2.1

Cost Analysis



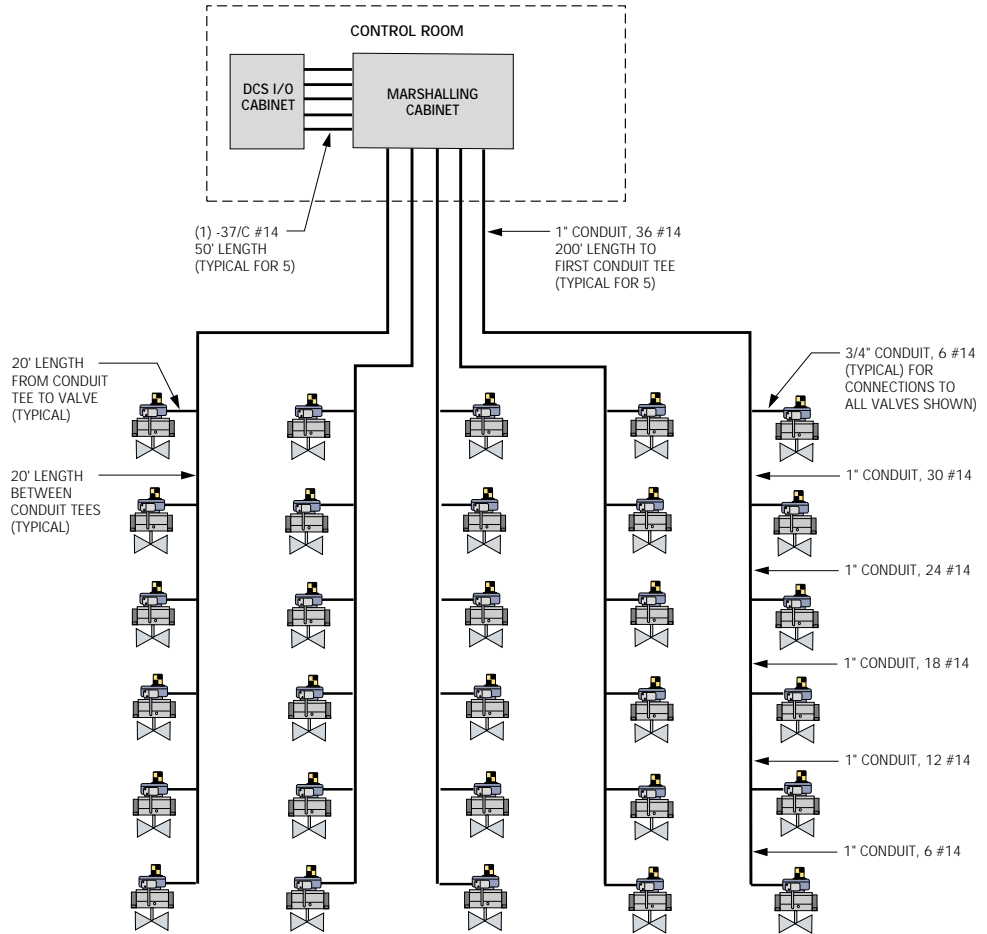
CONVENTIONAL SYSTEM

DCS with Central I/O

This sketch is typical for 4 field networks. (30 valves per network, 120 valves per system)

NOTES:

1. All valves shown are pneumatic actuated on/off type, with 3-way solenoid and open/close position sensors.
2. All conduit is above ground, rigid galvanized steel.
3. All #14 wiring is type THHN insulation



CONVENTIONAL SYSTEM (DCS with Central I/O)

MATERIAL DESCRIPTION	TAKEOFF QUANTITY		INSTALLATION LABOR				MATERIAL		TOTAL L&M COST
	AMOUNT	UNIT	PER UNIT	TOTAL HOURS	MH RATE	LABOR COST	COST/UNIT	MATERIAL COST	
3/4" Conduit	3600	feet	0.1	360.0	50	18,000	0.95	3,420	\$21,420
1" Conduit	4800	feet	0.1	480.0	50	24,000	1.39	6,672	\$30,672
Conduit Fittings & Supports	allowance	lot	-	672.0	50	33,600	-	14,600	\$48,200
#14 Wire	194400	feet	0.006	1,166.4	50	58,320	0.06	11,664	\$69,984
37/C #14 Multiconductor Cable	1000	feet	0.04	40.0	50	2,000	1.25	1,250	\$3,250
RS-232 Cabling	0	feet	0.008	-	50	-	0.75	-	-
Terminations	2920	each	0.08	233.6	50	11,680	0.05	146	\$11,826
Valve Solenoid & Position Sensors	120	each	0	-	50	-	450	54,000	\$54,000
Profibus Gateway & Power Supply	0	each	0	-	50	-	0	-	-
Marshalling Cabinet	360	each	0.075	27.0	50	1,350	80	28,800	\$30,150
Input/Output Hardware	360	per I/O point	0	-	50	-	100	36,000	\$36,000
TOTALS				2,979.0		\$148,950		\$156,552	\$305,502

AS-interface® Ver. 2.1

Cost Analysis



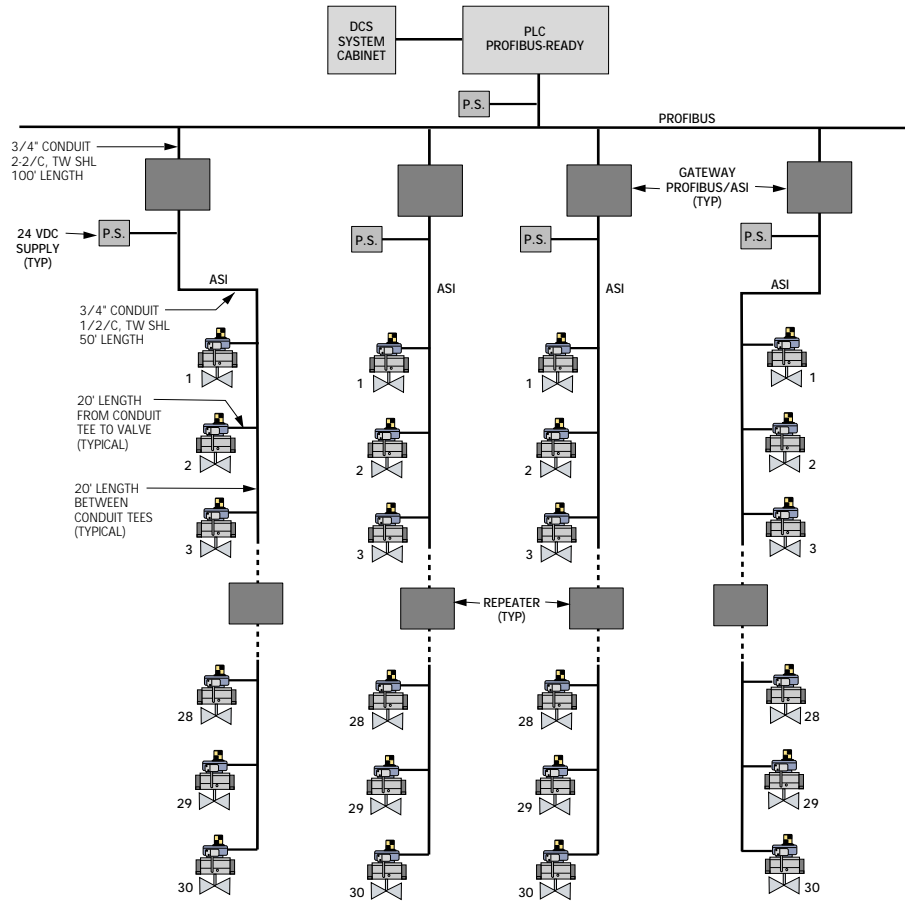
INTELLIS AS-interface Ver. 2.1 SYSTEM

DCS with Network Monitors

This sketch is typical for 4 field networks. (30 valves per network, 120 valves per system)

NOTES:

1. All valves shown are pneumatic actuated on/off type, with 3-way solenoid and open/close position sensors.
2. All conduit is above ground, rigid galvanized steel.



INTELLIS SYSTEM (DCS with AS-interface Network Monitors)

MATERIAL DESCRIPTION	TAKEOFF QUANTITY		INSTALLATION LABOR				MATERIAL		TOTAL L&M COST
	AMOUNT	UNIT	PER UNIT	TOTAL HOURS	MH RATE	LABOR COST	COST/UNIT	MATERIAL COST	
3/4" Conduit	5400	feet	0.1	540.0	50	27,000	0.95	5,130	\$32,130
1" Conduit	0	feet	0.1	-	50	-	1.39	-	-
Conduit Fittings & Supports	allowance	lot		432.8	50	21,600		4,104	\$25,704
#14 Wire	0	feet	0.006	-	50	-	0.06	-	-
37/C #14 Multiconductor Cable	0	feet	0.04	-	50	-	1.25	-	-
#16 Twisted Pair, Shielded	5400	feet	0.007	37.8	50	1,890	0.15	810	\$2,700
Profibus Drop Cable	400	feet	0.007	2.8	50	140	0.7	280	\$420
Profibus Trunk Cable	400	feet	0.007	2.8	50	140	1.2	480	\$620
RS-232 Cabling	0	feet	0.008	-	50	-	0.75	-	-
Terminations	720	each	0.08	57.6	50	2,880	0.05	36	\$2,916
Network Monitors	120	each	0	-	50	-	726	87.120	\$87,120
Profibus Gateway & Power Supply	4	each	0	-		-	1,800	7,200	\$7,200
Repeater	4	each					1,600	6,400	\$6,400
Marshalling Cabinet	0	each	0.075	-	50	-	80	-	-
Input/Output Hardware	0	per I/O point	0	-	50	-	100	-	-
TOTALS				1,073.0		\$53,650		\$111,560	\$165,210

AS-interface® Ver. 2.1

Cost Analysis



ENGINEERING/ DESIGN COSTS

Conventional System vs INTELLIS with AS-interface

The following tabulations are on a per valve basis for engineering and design activities normally associated with ON/OFF valves on a process industry capital project.

A total engineering/design savings of over **5 hours per valve** can be realized. On a project with 120 ON/OFF valves and an engineering billing rate of \$70/hr, savings would exceed **\$43,560**. A schedule **savings of 624 man-hours** would also be achieved.

ENGINEERING/DESIGN ACTIVITY	CONVENTIONAL ON/OFF VALVE	INTELLIS™ Network Monitors
P & ID Development/Production	0.1 hrs	0.1 hrs
Instrument Index Development/Production	0.5 hrs	0.5 hrs
I/O Address Assignments	0.3 hrs	0.1 hrs
I/O List Development/Production	1.5 hrs	0.5 hrs
Instrument Loop Diagram Design/Documentation	4 hrs	2 hrs
Marshalling Panel Design/Documentation	0.3 hrs	0 hrs
Field Terminal Box Design/Documentation	0.3 hrs	0.1 hrs
Electrical Cabling and Termination Lists.	2.25 hrs	0.75 hrs
Total Hours	9.25	4.05
Cost per Valve \$70/hr engineering billing rate	\$647.00	\$284.00

Savings per Valve = \$363.00

Savings per I/O Point (3 I/O per valve) = \$121.00

Total Engineering & Design Savings for 120 on/off valves = \$43,560

Total Schedule Savings = 624 Manhours

AS-interface® Ver. 2.1

Cost Analysis



▶ **COMPARATIVE
COST ANALYSIS
SUMMARY**

Conventional I/O System
vs INTELLIS® with AS-interface

The following is an abbreviated cost summary of the Distributed Control System wiring scheme outlined in the previous pages. The example utilizes a total of 120 pneumatically actuated on/off valves with 3-way solenoid and open/close position sensors. The entire system calls for a total of 360 I/O points (3 per valve).

CONVENTIONAL SYSTEM

Labor & Material Cost	\$305,502	
Cost per I/O Point		\$848
Engineering/Design Cost	\$77,640	
Cost per I/O Point		\$216
TOTAL COST	\$383,142	\$1,064/I/O pt

INTELLIS SYSTEM

Labor & Material Cost	\$165,210	
Cost per I/O Point		\$459
Engineering/Design Cost	\$34,080	
Cost per I/O Point		\$94
TOTAL COST	\$199,290	\$553/I/O pt

INTELLIS System Total Savings = \$183,852

Savings per Valve = \$1,532