Contents

Foreword i

Contents iii

List of exhibits vii

1 Introduction ..... 1 - 1

1.1 Background ..... 1 - 1
1.2 Purpose ..... 1 - 3
1.3 Objectives ..... 1 - 3
1.4 Scope ..... 1 - 4
1.5 Process ..... 1 - 5
1.7 Using this document ..... 1 - 9
1.8 Format ..... 1 -11
1.9 Superceded documents ..... 1 -14
1.10 Future of this document ..... 1 -15

2 General design requirement ..... 2 - 1

2.1 Basic design elements ..... 2 - 1
2.2 Simplicity ..... 2 - 2
2.3 Consistency ..... 2 - 2
2.4 Standardization ..... 2 - 3
2.5 Safety ..... 2 - 4
2.6 User-centered perspective ..... 2 - 6
2.7 Support ..... 2 - 8
2.8 Maintenance ..... 2 - 8

3 Automation ..... 3 - 1

3.1 General ..... 3 - 1
3.2 Design and evaluation ..... 3 - 6
3.3 System response and feedback ..... 3 - 7
3.4 Interface ..... 3 - 8
3.5 User acceptance and trust ..... 3 - 9
3.6 Modes ..... 3 -10
3.7 Monitoring ..... 3 -12
3.8 Fault management ..... 3 -16
3.9 False alarms ..... 3 -18
3.10 Training ..... 3 -19
3.11 Function allocation/levels of automation ..... 3 -21
3.12 Information automation ..... 3 -23
3.13 Adaptive automation ..... 3 -26
3.14 Decision aids ..... 3 -28
3.15 Control automation ..... 3 -33

4 Designing equipment for maintenance ..... 4 - 1

4.1 General ..... 4 - 1
4.2 Designing equipment for handling ..... 4 - 5
4.3 Packaging, arrangement, and mounting of equipment ..... 4 -15
4.4 Access openings ..... 4 -27
4.5 Cases, covers, guards, and shields ..... 4 -33
4.6 Fasteners ..... 4 -40
4.7 Connectors ..... 4 -51
4.8 Lines and cables ..... 4 -59
4.9 Packaging, layout, and mounting of internal components ..... 4 -79
4.10 Adjustment controls ..... 4 -89
4.11 Fuses and circuit breakers ..... 4 -91
4.12 Test points and service points ..... 4 -97
4.13 Test equipment ..... 4 -103
4.14 Tools ..... 4 -110

5 Displays and printers ..... 5 - 1

5.1 Displays . ..... 5 - 1
5.2 Cathode ray tube displays ..... 5 - 7
5.3 Flat-panel displays .... 5 -13
5.4 Liquid crystal displays ..... 5 -15
5.5 Gas plasma displays ..... 5 -17
5.6 Electroluminescent displays ..... 5 -17
5.7 Large-screen displays ..... 5 -18
5.8 Stereoscopic displays ..... 5 -21
5.9 Printers ..... 5 -22
5.10 Plotters and recorders ..... 5 -23
5.11 Accommodating people with disabilities ..... 5 -25

6 Controls and visual indicators ..... 6 - 1

6.1 Controls ..... 6 - 1
6.2 Visual indicators ..... 6 -52
6.3 Visual indicator-control integration ..... 6 -72
6.4 Accommodating people with disabilities ..... 6 -79

7 Alarms, audio, and voice ..... 7 - 1

7.1 Alarms and alerts ..... 7 - 1
7.2 Audio signals and audio alarms ..... 7 - 5
7.3 Voice signals and voice alarms ..... 7 -14
7.4 Voice communication systems ..... 7 -16

8 Computer-human interface ..... 8 - 1

8.1 Screen design ..... 8 - 1
8.2 Text entry and display ..... 8 - 6
8.3 Graphical information ..... 8 -31
8.4 Concealed information ..... 8 -52
8.5 Dynamic information update ..... 8 -52
8.6 Coding ..... 8 -54
8.7 Interaction ..... 8 -69

8.8 General interactive techniques ..... 8 -94
8.9 User-initiated interrupts ..... 8 -104
8.10 File management functions ..... 8 -106
8.11 Selection methods ..... 8 -108
8.12 Transaction options ..... 8 -112
8.13 Controls ..... 8 -115
8.14 Windows ..... 8 -132
8.15 System Operations ..... 8 -161
8.16 Help ..... 8 -176
8.17 Data communication ..... 8 -184
8.18 Accommodating people with disabilities ..... 8 -189

9 Input devices ..... 9 - 1

9.1 Keyboards ..... 9 - 4
9.2 Fixed-function keys ..... 9 - 6
9.3 Pointing devices ..... 9 - 7
9.4 Alternative input devices (non-keyboard, non-pointing devices) ..... 9 -21
9.5 Interchangeability among input devices ..... 9 -25
9.6 Accommodating people with disabilities ..... 9 -26

10 Workstation and Workplace design ..... 10 - 1

10.1 General ..... 10 - 1
10.2 Workstations and consoles ..... 10 - 2
10.3 Workplace layout ..... 10 -22
10.4 Design of passageways ..... 10 -26

11 System security ..... 11 - 1

11.1 General design practice ..... 11 - 2
11.2 Physical security and access control ..... 11 - 2
11.3 Identification and authentication ..... 11 - 3
11.4 Auditing ..... 11 - 6
11.5 Information and data protection ..... 11 - 6
11.6 Documentation of security safeguards ..... 11 - 8

12 Personnel safety ..... 12 - 1

12.1 General ..... 12 - 1
12.2 Work space safety ..... 12 - 1
12.3 Equipment-related safety ..... 12 - 6
12.4 Electrical hazards ..... 12 - 7
12.5 Physical hazards ..... 12 -16
12.6 Liquid and gas hazards ..... 12 -20
12.7 Toxic hazards ..... 12 -20
12.8 Radiation hazards ..... 12 -22
12.9 Protection from special chemicals ..... 12 -23
12.10 Temperature hazards ..... 12 -24
12.11 Fire protection ..... 12 -25
12.12 Noise hazards ..... 12 -26
12.13 Explosion and implosion hazards ..... 12 -29
12.14 Radiant energy hazards ..... 12 -30
12.15 Laser hazards ..... 12 -34
12.16 Safety labels and placards ..... 12 -35

13 Environment ..... 13 - 1

13.1 General ..... 3 - 1
13.2 Ventilation ..... 13 - 2
13.3 Temperature and humidity ..... 13 - 4
13.4 Illumination ..... 13 - 9
13.5 Noise ..... 13 -18

14 Anthropometry and biomechanics ..... 14 - 1

14.1 General application of anthropometric and biomechanic data ..... 14 - 2
14.2 Anthropometric variability factors ..... 14 -13
14.3 Anthropometric and biomechanics data ..... 14 -13
14.4 Reach ..... 14 -35
14.5 Human strength and handling capacity . ..... 14 -42
14.6 Wheelchair anthropometrics ..... 14 -52

15 User documentation ..... 15 - 1

15.1 General ..... 15 - 1
15.2 Writing user documentation ..... 15 - 4
15.3 Layout and formatting ..... 15 -18
15.4 Components of documents ..... 15 -31
15.5 Specific user document contents ..... 15 -50
15.6 Accommodating people with disabilities ..... 15 -68