

HEALTH AND SAFETY IN EMPLOYMENT ACT 1992

APPROVED CODE OF PRACTICE FOR

**THE DESIGN, SAFE OPERATION,
MAINTENANCE AND SERVICING OF**

BOILERS



Published by the Occupational Safety and Health Service
Department of Labour
Wellington
New Zealand

First edition	March 1996
Revised	April 2000
Amendment No.1 incorporated	December 2004

ISBN 0-477-03629-5

Table of Contents

Notice of Issue	9
Foreword	10
<i>Summary of the Health and Safety in Employment Act 1992</i>	<i>11</i>
Regulations	11
Approved codes of practice	11
Employers' duties	11
Hazard management	12
Information for employees	12
Employers to involve employees in the development of health and safety procedures	13
Training of employees	13
Safety of people who are not employees	13
Employees' and self-employed persons' duties	13
Accidents and serious harm (recording and notification)	13
Health and Safety in Employment Regulations 1995	14
<i>Part 1: General Requirements</i>	<i>15</i>
1.1 Purpose and application	15
1.2 Scope	16
1.3 Background	16
1.4 Definitions	17
1.5 General hazards	23
1.6 Supervision	24
1.7 Existing boilers	24
1.8 Upgrading existing shell boilers	25
1.9 Coupled boilers	25
1.10 Combustion	26
1.11 General design requirements	26
1.12 Manufacture and workmanship	30
1.13 Fittings	30
1.14 Water level gauges	31
1.15 Safety valves	32
1.16 Pressure gauge	33
1.17 Blowdown arrangement	34

1.18	Water treatment	34
1.19	Feed pumps	34
1.20	Feedwater systems	35
1.21	Electrical equipment and supply	35
1.22	Control components	36
1.23	Fault alarms and lock-outs	37
1.24	Testing of controls and alarms	38
1.25	Boiler control systems including programmable logic controller (PLC)	38
1.26	Documents and marking	39
1.27	Duties of controllers	39
1.28	Maintenance	40
1.29	Inspection and testing	41
1.30	Security and protection	43
1.31	Quality management systems for boilers	46
1.32	System auditing/monitoring	46
1.33	Method of application for limited-attendance and unattended boilers operation	46
1.34	Importers, distributors and resellers	47

Part 2: Attended Boilers 48

2.1	Boilers with output greater than 20 MW	48
2.2	Attended boilers with outputs not exceeding 20 MW	48
2.3	Controls and mountings	48
2.4	Low-water lock-outs and alarms	49
2.5	Feedwater control	49
2.6	Operational supervision	49
2.7	Daily tests	50

Part 3: Limited-Attendance Boilers 51

3.1	Controls and mountings	51
3.2	First low-water lock-out and alarm	52
3.3	Second low-water lock-out and alarm	52
3.4	Feedwater control	53
3.5	Feedwater availability lock-out and alarm	53
3.6	Feedwater low-pressure or low-flow lock-out and alarm	53
3.7	Forced circulation	54

- 3.8 Combustion controls 54
- 3.9 Combustion chamber thermal cut-out and alarm 54
- 3.10 Power failure safeguards for solid fuel boiler installations 54
- 3.11 Alarms 55
- 3.12 Visual display 56
- 3.13 Operational supervision 56
- 3.14 Testing of lock-outs, cut-outs and alarms 57
- 3.15 Periodic tests 57
- 3.16 Water treatment 57
- 3.17 Maintenance of the boiler control and safety systems 58

Part 4: Under 15 HP Boilers 59

- 4.1 General 59
- 4.2 Controls and mountings 59
- 4.3 Operational supervision 59
- 4.4 Under 15 hp boilers built to Standard other than
BS 2790: 1982, or to earlier editions of that Standard 60
- 4.5 Under 15 hp boilers built to BS 2790:1982, or to later
editions of that Standard 60
- 4.6 Coupled boilers 60
- 4.7 Existing boilers 60

Part 5: Unattended Boilers 61

- 5.1 Operation 61
- 5.2 Controls and mountings 61
- 5.3 First low-water lock-out alarm 62
- 5.4 Second low-water lock-out and alarm 62
- 5.5 Feedwater control 63
- 5.6 Feedwater availability lock-out and alarm 64
- 5.7 Feedwater low-pressure or low-flow lock-out and alarm 64
- 5.8 Forced circulation 64
- 5.9 Combustion controls 64
- 5.10 Combustion chamber thermal cut-out and alarm 65
- 5.11 Power failure safeguards for solid fuel boiler installations 65
- 5.12 Alarms 66
- 5.13 Visual display 66
- 5.14 Operational supervision 66

5.15	Testing of lock-outs, cut-outs and alarms	68
5.16	Quarterly tests	68
5.17	Water treatment	69
5.18	Boiler control system	69
<i>Part 6: Once-Through Forced Circulation Coil Boilers</i>		<i>70</i>
6.1	Standards for controls	70
6.2	Forced circulation coil boilers	70
6.3	Feedwater pump	71
6.4	Pressure safety	71
<i>Part 7: Small Boilers</i>		<i>72</i>
7.1	Standards for controls	72
7.2	Operational supervision	72
<i>Part 8: Pressurised Hot Water Boilers</i>		<i>73</i>
8.1	Standards	73
8.2	Types of system	73
8.3	Automatic controls	74
8.4	Independent overriding controls	75
8.5	Electrical failure to safety	75
8.6	Interruption to the electricity supply	75
8.7	Boilers using mixing valves	76
8.8	Safety valves	76
8.9	Training	76
8.10	Testing and maintenance	76
<i>Part 9: Unfired Waste Heat Boilers</i>		<i>77</i>
9.1	Definition	77
9.2	Design	77
9.3	Safety protection devices	77
9.4	Special applications	77
<i>APPENDIX A: Principal Standards Accepted for Use in New Zealand in Connection with Boilers</i>		<i>79</i>
A1.	New Zealand Standards	79
A2.	Joint Australian/New Zealand Standards	79
A3.	Australian Standards	79

A4. British Standards	80
A5. U.S.A. Standards	80
A6. Miniature Boiler Standards (for information - not covered by the code)	81
A7. Existing boilers	81
 <i>APPENDIX B: Clauses from AS 2593: 1995 to be Considered for Boiler Design Purposes</i>	 <i>82</i>
 <i>APPENDIX C: Information Needed by the Authority with First Application to Operate an Unattended or Limited Attendance Boiler</i>	 <i>83</i>
C1. Method of application for limited-attendance boiler operation and unattended boiler operation	83
C2. Operation and maintenance	85
 <i>APPENDIX D: Guidelines for the Design Verification of Boiler Control Systems (BCS)</i>	 <i>87</i>
D1. Type acceptance of boiler controls	87
D2. Documentation and design statements	87
D3. The use of control components not covered by an 'applicable standard'	88
D4. Design verification of boiler controls	88
 <i>APPENDIX E: Commissioning Test of Boiler Control System for Limited-Attendance and Unattended Boilers</i>	 <i>89</i>
 <i>APPENDIX F: Boiler Ratings</i>	 <i>94</i>
F1. Boiler output rating	94
F2. "From and at" evaporative capacity rating	95
F3. Boiler "horsepower rating"	96
 <i>APPENDIX G: Conformity Assessment</i>	 <i>97</i>
G1. Introduction	97
G2. Inspection bodies	98
G3. Quality management system	98

G4. Design verification 98

G5. Fabrication inspection 101

APPENDIX H: Accident Notification (No Serious Harm) 104

Notice of Issue

I have issued this Approved Code of Practice for the Design, Safe Operation, Maintenance and Servicing of Boilers, being a statement of preferred work practices or arrangements for the purpose of ensuring the health and safety of persons to which this code applies and persons who may be affected by the activities covered by this code.

A handwritten signature in black ink, appearing to read 'J.M. Chetwin', with a horizontal line underneath it.

J.M. Chetwin
Secretary of Labour
April 2000

Foreword

I have approved this statement of preferred work practices, which is an *Approved Code of Practice for the Design, Safe Operation, Maintenance and Servicing of Boilers*, under section 20 of the Health and Safety in Employment Act 1992. When a code is approved, a Court may have regard to it in relation to compliance with the relevant sections of the Health and Safety in Employment Act. This means that if an employer in an industry or using a process to which an approved code applies can show compliance with that code in all matters it covers, a Court may consider this to be compliance with the provisions of the Act to which the code relates.



Hon. Margaret Wilson
Minister of Labour
April 2000

Summary of the Health and Safety in Employment Act 1992

The principal object of the Health and Safety in Employment Act 1992 is to prevent harm to employees at work. To do this, it imposes duties on employers, employees, principals and others, and promotes excellent health and safety management by employers. It also provides for the making of regulations and codes of practice.

We recommend that you read this summary in conjunction with the Health and Safety in Employment Act 1992

Regulations

Regulations are promulgated from time to time under the HSE Act. Regulations may impose duties on employers, employees, designers, manufacturers, and others relating to health and safety. These regulations may apply with respect to places of work, plant, processes or substances and may have been made to deal with particular problems that have arisen.

Approved Codes of Practice

"Approved Codes of Practice" are provided for in section 20 of the HSE Act. They are statements of preferred work practice or arrangements, and may include procedures which could be taken into account when deciding on the practicable steps to be taken. Compliance with codes of practice is not mandatory. However, they may be used as evidence of good practice in court.

Employers' Duties

Employers have the most duties to perform to ensure the health and safety of employees at work.

Employers have a general duty to take all practicable steps to ensure the safety of employees. In particular, they are required to take all practicable steps to:

- Provide and maintain a safe working environment;
- Provide and maintain facilities for the safety and health of employees at work;
- Ensure that machinery and equipment is safe for employees;
- Ensure that working arrangements are not hazardous to employees; and
- Provide procedures to deal with emergencies that may arise while employees are at work.

Taking "all practicable steps" means what is reasonably able to be done to achieve the result in the circumstances, taking into account:

- The severity of any injury or harm to health that may occur;

- The degree of risk or probability of that injury or harm occurring;
- How much is known about the hazard and the ways of eliminating, reducing or controlling it; and
- The availability, effectiveness and cost of the possible safeguards.

Hazard Management

Employers must have an effective method to identify and regularly review hazards in the place of work (existing, new and potential). They must determine whether the identified hazards are significant hazards and require further action. If an accident or harm occurs that requires particulars to be recorded, employers are required to investigate it to determine if was caused by or arose from a significant hazard. "Significant hazard" means a hazard that is an actual or potential cause or source of:

- Serious harm;
- Harm (being more than trivial) where the severity of effects on a person depends (entirely or among other things) on the extent or frequency of the person's exposure to the hazard; or
- Harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.

Where the hazard is significant, the HSE Act sets out the steps employers must take:

- Where practicable, the hazard must be eliminated;
- If elimination is not practicable, the hazard must be isolated;
- If it is impracticable to eliminate or isolate the hazard, the employer must minimise the likelihood that employees will be harmed by the hazard.

Where the hazard has not been eliminated or isolated, employers must:

- Ensure that protective equipment is provided, accessible and used;
- Monitor employees' exposure to the hazard;
- Seek the consent of employees to monitor their health; and
- With their informed consent, monitor employees' health.

Information for Employees

Before employees begin work, they must be informed by their employer of:

- Hazards employees may be exposed to while at work;
- Hazards employees may create which could harm people;
- How to minimise the likelihood of these hazards becoming a source of harm to themselves and others;
- The location of safety equipment; and

- Emergency procedures.

Employees should be provided with the results of any health and safety monitoring. In doing so, the privacy of individual employees must be protected.

Employers to Involve Employees in the Development of Health and Safety Procedures

Employers need to ensure that all employees have the opportunity to be fully involved in the development of procedures for the purpose of identifying and controlling significant hazards, or dealing with or reacting to emergencies and imminent dangers.

Training of employees

Employers must ensure employees are either sufficiently experienced to do their work safely or are supervised by an experienced person. In addition, employees must be adequately trained in the safe use of all plant, objects, substances and protective clothing and equipment that the employee may be required to use or handle.

Safety of People Who are Not Employees

Employers also have a general duty towards persons who are not employees.

Employers must take all practicable steps to ensure that employees do not harm any other person while at work, including members of the public or visitors to the place of work.

Employees and Self-Employed Persons' Duties

Employees and self-employed persons have a responsibility for their own health and safety while at work. They must also ensure that their own actions do not harm anyone else.

However, these responsibilities do not detract from the employer's responsibilities.

Accidents and serious harm (recording and notification)

The HSE Act requires employers to keep a register of work-related accidents and serious harm. This includes every accident that harmed (or might have harmed):

- Any employee at work; or
- Any person in a place of work under the employer's control.

Employers are also required to investigate all accidents and near-misses to determine whether they were caused by or arose from a significant hazard.

Employers are required to notify serious harm that occurs to employees while at work to the Secretary of Labour (in practice, the nearest OSH office), as soon as

possible. In addition, the accident must also be notified in the form prescribed within 7 days. (Suitable forms for notification are available from OSH offices and selected stationers.)

If a person suffers serious harm, the scene of the accident must not be disturbed unless to:

- Save life or prevent suffering;
- Maintain public access for essential services, e.g. electricity, gas; or
- Prevent serious damage or loss of property.

The OSH office will advise whether it wishes to investigate the accident and what action may be taken in the meantime.

Health and Safety in Employment Regulations 1995

The Health and Safety in Employment Regulations 1995 extend the provisions of section 6 of the Act in relation to the provision of amenities such as toilets, washing and first aid facilities, and the provision of wholesome and sufficient drinking water.

The regulations also place duties on employers in relation to specific hazards; such as work at heights of over 3 metres (regulation 21), scaffolding (regulation 22), notifiable work (regulation 26) and work under raised objects (regulation 16).

Part VII of the regulations places specific duties on designers, manufacturers and suppliers of plant.

PART 1: General Requirements

1.1 Purpose and Application

This approved code of practice was prepared and revised by a technical committee comprising representatives from the Insurance Council, inspection bodies, classification societies, the NZ Employer's Federation, Manufacturer's Association, Heavy Engineering Research Association, NZ Combined Trade Unions, Association of Marine, Aviation and Power Engineers, and OSH's Engineering Safety Group. Its purpose is to update and bring together into one document the minimum requirements for the design, safe operation, maintenance and servicing of boiler plant.

With the advent of more stringent boiler manufacturing standards (chiefly relating to weld inspection and tubesheet design) and the availability of high-integrity, self-monitoring controls, boiler plant now presents no more danger to personnel than many other pressure equipment items in general use. Accordingly, the committee saw fit to extend the limits for unattended steam boilers in line with current overseas practice. This relaxation of the manning requirements imposes substantial obligations on the controller to ensure that this code is followed, and that boiler supervisory and maintenance staff have adequate training.

This code also includes high-temperature hot water boilers.

This part outlines general requirements for boilers and hot water boilers, as defined in the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999. It applies to all commercial and industrial boilers including fired and waste heat boilers (Heat Recovery Steam Generators - HRSG) of shell, fire tube and water tube design, including coil boilers and transportable boilers.

It does not apply to electric and electrode boilers.

Every new boiler shall comply with a Standard that is acceptable in New Zealand, as listed in Appendix A of this code, and with the requirements of this code.

Limited-attendance and unattended boilers with output greater than 6 MW shall be operated and maintained within a certified AS/NZS ISO 9001:2000 Quality Management System, as specified in clause 1.31. For boiler ratings, refer to Appendix F.

Limited-attendance and unattended boilers with outputs not exceeding 6 MW may be operated and maintained within a documented boiler operation and maintenance system, as specified in clause 1.31.

The necessity for this revised edition arose as a consequence of technological development, regulatory changes and submissions received from the industry during the past four years of administering the previous edition of this code by the Engineering Safety Group.

The subsequently incorporated amendment (Amendment No.1) was formulated with the benefit of appropriate industry input.

1.2 Scope

This code covers the design, safe operation, maintenance and servicing of boilers and applies to the safety features and controls of all commercial or industrial boilers.

Only the following categories of boilers can be operated as unattended or limited-attendance boilers:

- Water tube boilers of welded construction designed and built to BS 1113;
- Water tube boilers of welded construction designed and built to the ASME Boiler and Pressure Vessel Code section 1 "*Power Boilers*";
- Shell boilers of welded construction designed and built to BS 2790:1982, and later editions of this standard;
- Shell boilers and water-tube boilers of welded construction, designed and built to AS 1228;
- Some shell boilers of welded construction built to earlier editions of BS 2790, and some welded shell boilers designed and built to the New Zealand Boiler Code; and
- Heat recovery steam generators (HRSG), waste heat boilers, electric and electrode boilers designed and built to the ASME Boiler and pressure vessel code section *VIII Rules for construction of pressure vessels* or NZS BSPD 5500 *Specification for unfired fusion welded pressure vessels* (or earlier designs to BS 5500).

For other boiler types, the standards listed in Appendix A of this code shall apply.

NOTE: The 1982 edition of BS 2790 was the first edition of this standard to contain requirements which recognised and reflected the influence of thermal aspects of combustion on tube plate design and non-destructive examination (NDE) on determination of scantlings.

This code does not apply to boilers of an historic type (vintage locomotives, traction engines, etc.). Nor does it apply to boilers operated solely for educational or display purposes.

1.3 Background

At the time of writing, approximately 75% of steam boilers in New Zealand are under 15 horsepower (for boiler ratings refer to Appendix F of this code). They do require supervision but not necessarily by a fulltime qualified operator. While there have been no fatalities associated with failures of these boilers in the past 30 years, there have been a number of collapsed furnaces due to lack of water, and other potentially serious failures.

Adoption of this code will provide an increased level of safety for all types of boiler plant.

1.4 Definitions

Approved Maintenance Contractor means a person who is suitably skilled and fully understands the functions and purposes of the boiler control system.

The person shall be nominated by the boiler controller and shall:

- (a) Meet the requirements of, and be acceptable to, the boiler manufacturer; or
- (b) Be approved by an inspection body, provided that the person:
 - (i) Is appropriately qualified and experienced and satisfies the criteria required by C1.1(e); and
 - (ii) Has all the technical data necessary for maintenance of the boiler management and safety systems.

Within an AS/NZS ISO 9001:2000 certified Quality Management System (QMS) of appropriate scope, or other system as permitted by 1.31.4, this function may be carried out "in-house".

For work on boiler management and safety systems, additional requirements are defined for limited-attendance and unattended boilers in 3.17 and 5.18 respectively.

Attended boiler means a boiler which is under the direct control of a qualified operator at all times when steam is being raised or is being taken from the boiler.

Authorised means approved by the Authority.

Authority means the Occupational Safety and Health Service of the Department of Labour, which is currently the government agency having the delegated responsibility from the Secretary for administering these requirements.

Boiler

- (a) Means a device -
 - (i) Most of which is an arrangement of pressure containment parts; and
 - (ii) The purpose of which is to generate steam -
 - (A) By the use of a directly applied combustion process; or
 - (B) By the application of heated gases; and
- (b) Includes any of the following:
 - (i) Boiler piping:
 - (ii) Combustion equipment:
 - (iii) Combustion management systems:
 - (iv) Controls:
 - (v) Economisers:
 - (vi) Fans:
 - (vii) Feed and circulating pumps:
 - (viii) Pressure fittings:
 - (ix) Reheaters:

- (x) Superheaters:
- (xi) Supports:
- (xii) Water level management systems: but

(c) Does not include a hot water boiler.

NOTE: See *Boiler perimeter* definition.

Boiler control system (BCS) means a system that controls the entire boiler function including the energy input management system, the water level management system, the alarm system, the pressure controls, trip devices, all instruments, and circuitry. Note: This was previously referred to as the boiler management system (BMS).

Boiler manufacturer means the person who oversees the fabrication, installation, commissioning and certification of the boiler with all its systems and ancillary equipment, and the training of the operating staff. For boilers being relocated or refurbished, the person carrying out that operation is considered to have the same responsibilities as detailed above for the boiler manufacturer.

Boiler output means the heat transferred to the water/steam between the feed inlet and the boiler water/steam outlet(s). This includes any heat transferred in economiser(s) and superheater(s). See also Appendix F of this code.

Boiler perimeter is generally to be taken as the outlet connection from the main and auxiliary steam stop valves, the inlet connection to the feedwater valves or feedwater controller, the first connection to the inlet of the reheat inlet header, the first connection to the outlet of the reheat outlet header, the point of release to atmosphere of both the safety valve discharge piping and the blowdown discharge piping, the last connection of fuel supply, hot gas supply, air supply and the first connection of the flue gas discharge piping or ducting.

For new installations, the limits of a boiler shall be as defined in the standard used for its design and fabrication. For existing installations, where the standard used for design and fabrication defines the limits of the boiler, then the definition in the standard shall be used.

Boiler safety controls means those items on which the safety of the boiler depends and are required to be of a fail-safe nature.

Capacity means the boiler output at maximum continuous rating specified by the boiler manufacturer.

Certificate of inspection* means a certificate issued or renewed under regulation 32 that complies with regulation 33. In the case of an in-house inspection body, the certificate may take the form of a computer record created by that body on the recommendation of the equipment inspector.

Certification body means an organisation carrying out certification of quality management systems to AS/NZS ISO 9001:2000 and with the current and appropriate JAS-ANZ (Joint Accreditation System for Australia and New Zealand) accredited scope.

Competent person means a person who has acquired, through training, qualification or experience, or a combination of these, the knowledge and skills enabling that person to perform the task required.

Controller means a person who is the owner, lessee, sublessee, or bailee, of equipment in a place of work (not being a home occupied by the person).

Cut-out means a condition in which the device or system under consideration has been turned off and can automatically restart after the fault has been corrected. The associated audible and visible alarms still remain activated and require manual operator resetting.

Data logger means an automatic device which gives a printout of all safety related events and functions, together with the times that they occur and details of the corrective actions applied. The printout may also include regular details of critical or essential operational data.

Designer means a designer of equipment that could reasonably be expected to be operated in a place of work.

Design pressure means the pressure used by the designer for the purpose of calculating pressure parts of the boiler.

Design verification means verification that the following comply, in every respect related to safety, with the requirements of the appropriate design standards and contain every safety feature that is relevant, whether or not referred to in those standards:

- (a) Designs of equipment; and
- (b) Alterations to designs, affecting the structural strength or safety of equipment, made in the course of manufacture; and
- (c) Designs of a repair or alteration affecting operational safety of the equipment repaired or altered or any other equipment; and
- (d) The fabrication inspection requirements specified by the designer.

Design verifier* means a person who –

- (a) Is employed or engaged by an inspection body to carry out the functions referred to in regulation 26; and
- (b) Is the holder of a relevant certificate of competence.

Equipment inspector* means a person who –

- (a) Is employed or engaged by an inspection body to carry out the functions referred to in regulation 27; and
- (b) Is the holder of a relevant certificate of competence.

Fail-safe means a feature which ensures that absence of any critical control or safety component, system, signal, or function can not permit an unsafe condition to arise.

Flame establishment period means the period that begins when the fuel valve is energised and ends when the flame supervision system is first required to supervise that flame.

Flame failure means an abnormal loss of flame as detected by the flame supervision system.

Flame supervision system means a system consisting of flame detector plus associated circuitry, integral components, valves and interlocks, the function of which is to

shut off the fuel supply to the combustion equipment in the event of ignition failure or flame failure.

"From and at 100°C" is an abbreviation indicating the evaporation from feedwater at 100°C to steam at 100°C and as such is the basis of determining the peak load equivalent evaporation of a steam boiler. It is a means of standardising the evaporation rating of a boiler relative to the heat transfer. See also Appendix F of this code.

Hardwired means wired directly and independently from a particular boiler safety control to its lock-out device and not linked through a programmable logic controller (PLC).

High-integrity controls in the case of low water alarms, for example, this means controls which are fail-safe and self-monitoring incorporating a regular self-checking routine. The design must be such that faults which could compromise the effectiveness of the safety device cannot occur (by fault avoidance techniques) or that in the event of internal faults or the occurrence of external influences in or at the safety device, then its effectiveness remains unaffected or the plant remains in a safe condition, or is brought to a safe condition.

Fail-safe, self-monitoring controls incorporating a regular self-test are the preferred control system and may be termed "high-integrity."

Horsepower This was a classification of boiler output, based on the area of heat transfer surface, and was practically equal to the heating surface area in m² of the boiler divided by 1.5. See also Appendix F of this code. It is not proposed to continue this measurement method but it is included here for comparative purposes.

Hot water boiler

(a) means a device

(i) Most of which is an arrangement of pressure containment parts;

and

(ii) That does not produce or contain steam; and

(iii) The purpose of which is to heat water at pressures exceeding 200kPag and temperatures exceeding 100°C :

(A) By the use of a directly applied combustion process; or

(B) By the application of heated gases; and

(b) Includes any of the following that is necessary to ensure the pressure integrity of the device or its safe operation:

(i) Boiler piping:

(ii) Combustion equipment:

(iii) Combustion management systems:

(iv) Controls:

(v) Controls for water temperature and flow:

(vi) Fans:

(vii) Pressure fittings:

(viii) Pumps:

(ix) Supports: but

(c) Does not include a device of a kind that could reasonably be expected to be used only for domestic water heating.

Ignition failure means the failure of the ignition system to establish flame by the end of the flame establishment period.

Immediate vicinity means on or around the boiler itself, or in the control room or at the control position designated for that boiler.

Incident means an event involving equipment within the scope of these requirements which causes structural damage to that equipment, or damage to other property, which in turn may in any manner affect its ongoing safety, or which in different circumstances may have caused an accident.

Inspection body means:

- (1) An organisation currently recognised under regulation 25; and
- (2) In relation to a design verifier or equipment inspector, the inspection body by which the design verifier or equipment inspector is employed or engaged.

An inspection body may be a Type A, B or C as defined by ISO 17020.

Interlock means a device that makes the operation of an item of equipment dependent upon the fulfilment of predetermined conditions by another item of equipment.

Internal means inside the boiler drum or boiler shell.

Limited-attendance boiler means a boiler that -

- (a) May be started up or shut down automatically or under manual control; and
- (b) When operating, is checked at regular intervals by the holder of a relevant certificate of competence, who is on site and within range of the boiler's audible or visual alarms at all time; and
- (c) May be brought at any time under the direct control of a holder of a relevant certificate of competence.

Lock-out means a condition in which the device or system under consideration has been turned off and can be restarted only after the fault has been corrected and the system manually reset by the qualified operator or responsible person.

Manufacturer means a manufacturer of equipment that could reasonably be expected to be operated in a place of work

Operation and maintenance system means a documented management system for the operation, maintenance and control of a boiler or boilers (limited attendance or unattended) with an aggregate output not exceeding 6MW. This system incorporates the relevant main parts of a quality management system and is to be audited by an equipment inspector holding a current certificate as a boiler inspector (with no restrictions or limitations). Further details are provided in Appendix C of this code.

Pressure means the pressure above the atmospheric pressure.

Pressure relief means the controlled and automatic relief of pressure to a safe disposal location or system by the operation of a safety device.

Pressure test means a hydraulic or pneumatic test carried out by applying a pressure greater than the safe working pressure to pressure-retaining parts or sections of pressure equipment to prove the pressure integrity of the construction, or, the adequacy of modifications or repairs made to it.

Proved means that the relevant conditions have been sensed and the correct response given.

Purging means the use of air or inert gas to remove and replace a potentially dangerous atmosphere.

Qualified operator means a person who holds the appropriate competency certificate for the control of the combined size of the boilers in question.

Quality management system* means a system to which regulation 28(1) applies.

Regulations referred to in this code means the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999.

Responsible person means a person who is appointed by the controller and who is trained to the level specified by the manufacturer of the boiler, or to a level acceptable to an inspection body, to exercise general supervision of the safe operation of the boiler.

Safe working pressure means the pressure for which the equipment has been designed to safely operate in accordance with specific requirements of the relevant primary applicable design standard (see Appendix A of this code) or a lower pressure assigned to the equipment for safety reasons, provided the safety valves, or safety relief valves, are reset accordingly.

Secretary means the Chief Executive of the Department of Labour.

Self-checking system means a sub-circuit within the boiler control system, designed and arranged to automatically and regularly test the integrity of low water and flame-failure devices by functional testing of each and every component on which safe and correct operation is dependent, usually by creating a change of state.

Self-monitoring system a sub-circuit within the boiler control system that continually monitors the integrity of the control components and their interconnections.

Shutdown means a condition in which the boiler is immediately and effectively isolated from all sources of fuel and power (or combustion air and power for solid fuel boilers), and where the controls can be reset only by hand. The safety control and alarm system shall not be isolated.

Small boiler means a boiler with a total volume less than 1500 litres, an operating pressure not exceeding 1000 kPa and an output less than 500 kW.

Steam means water vapour at a pressure equal to or greater than atmospheric pressure and a temperature equal to or greater than 100°C.

Supervise, supervision means having effective control over the related operations or functions.

Unattended boiler means a boiler that can start up, operate, and shut down only under –

- (a) The control of the boiler control system; and
- (b) The monitoring of the safety system.

* Where regulations are mentioned in the above definitions, they refer to the Health and Safety in Employment (Pressure Equipment, Cranes, and Passenger Ropeways) Regulations 1999.

1.5 General Hazards

1.5.1 This code is directed at the hazards associated with:

- Control system malfunction;
- Fire;
- Fire side explosion;
- Loss of power supply;
- Loss of water;
- Overpressure;
- Overheating;
- Unauthorised access; and
- Unauthorised modifications and repairs.

1.5.2 Overheating as a result of low water is the most common cause of boiler damage or explosions, usually a result of the malfunction of the automatic controls. The main reasons for these incidents has been shown to be:

- Build-up of scale;
- Inadequate supervision;
- Isolation of float control chambers and safety controls;
- Lack of maintenance of controls and alarms; and
- Lack of testing of controls and alarms.

NOTE: Under no circumstances should feedwater be pumped into a boiler that is subjected to low water and is overheated.

1.5.3 All boilers should be warmed through from cold according to the manufacturer's instructions. Automatic boilers' start-up and shut down sequences shall be designed to ensure that the boiler does not suffer thermal shock through rapid heating or cooling.

1.5.4 All boilers with a perceptible water level shall be adequately restrained (see clause 1.11.1.4) and shall be reinspected when relocated. This may not necessarily apply to small coil boilers with output less than 250 kW.

1.5.5 Special-application water tube boilers may be assessed for unattended or limited-attendance operation on their ability to guarantee at least equivalent levels

of safety to that required by this code. This equivalency shall be established by an inspection body through an acceptable equipment conformity assessment process.

- 1.5.6 Persons installing boiler control systems or controls, for both new installations and upgrades of existing plant, shall be suitably qualified, trained and experienced with boiler control systems to be able to assure a safe system. For the detailed design verification requirements for BCS, refer to the Appendix D of this code.

1.6 Supervision

- 1.6.1 Automatic controls are not a complete substitute for supervision. A measure of supervision by a qualified operator or responsible person familiar with the automatic controls and the operation of the boiler house plant is an essential feature of safe operation.
- 1.6.2 In deciding the extent of supervision needed, the following points as well as table 1.3 of this code shall be taken into account:
- (a) The complexity of the installation;
 - (b) The extent of automation and integrity of the boiler controls; and
 - (c) The operating conditions of the boiler and controls.

1.7 Existing Boilers

The following general requirements and restrictions shall apply to all existing boilers:

- 1.7.1 Existing boilers may continue to be operated under their present location and condition as long as they remain in good enough condition to be issued with a certificate of inspection
- 1.7.2 Existing attended boilers that are upgraded to unattended or limited-attendance status do not need to have their seismic conditions design verified against the current seismic requirements, as long as they are not relocated. For boilers whose upgrade includes relocation, see clauses 1.7.3 and 1.11.1.5.
- 1.7.3 Boilers which are relocated, structurally damaged, or having been stored and taken back into service after a period of 24 months without having a certificate of inspection issued by an inspection body, shall have their controls upgraded to meet the requirements for that class of boiler specified in this code in full.
- 1.7.4 Any change from the existing attended operation to unattended or limited-attendance operation must be registered with the Engineering Safety Group of OSH. The application procedure for the registration of unattended or limited-attendance boilers is outlined in Appendix C of this code.
- 1.7.5 Existing attended boilers that have a level of equipment less than that required in Part 2 of this code, and that are not covered by clause 1.7.3 above, may continue to be operated by a qualified operator in the immediate vicinity of the boiler at all times. The 50 m limit given in clause 2.6 only applies to boilers that fully comply with this code.

1.8 Upgrading existing shell boilers

- 1.8.1 Controllers wishing to have their existing attended shell boiler upgraded to limited attendance or unattended operation, or their existing attended under 15 HP boiler, upgraded to unattended operation shall have the boiler examined by an equipment inspector to determine its suitability for the conversion.
- 1.8.2 *T-butt weld between the furnace tube and the tube plate on shell boilers.* Shell boilers that do not have a full penetration, double-sided weld of the required quality for the full circumference of the furnace tube shall not be considered suitable for upgrading.
- 1.8.3 Flat plates attached to reversal chambers or firebox wrapper plates shall have reverse side fillet welds, with a minimum leg length of 5 mm, inserted for the full circumference of the seam.
- 1.8.4 Flat plates attached to shells and furnace shall have reverse side fillet welds, with a minimum leg length of 6 mm, inserted for the full circumference of the seam.
- 1.8.5 Welds, including T-butt welds, in the shell, end plates, furnace and reversal chamber shall be checked and shall be free from cracks caused through operation.
- 1.8.6 Upgrade work shall take into consideration all the relevant aspects of the original design standard, including stress-relieving where necessary:
 - (i) Stress-relieving shall meet the requirements set out in the standard the boiler was designed to, or where the standard has been withdrawn, to the requirements of the latest revision of BS 2790.
 - (ii) Any weld repairs carried out on main structural strength welds, e.g. on main shell, endplates or furnace, shall be stress-relieved in accordance with the design standard.
- 1.8.7 Tube plates shall be inspected, using appropriate non-destructive examination methods, and confirmed free of cracking. For designation of tube plate temperature maximum value, refer to clause 1.11.5.
- 1.8.8 Factors which will adversely affect a boiler's suitability for upgrading include:
 - Lack of double full-penetration weld furnace/tubeplate, or defects outside the specified limits;
 - Previous repair to tube plate, shell or other major component;
 - Signs of forced firing, overheating, cracked back tube plate, etc;
 - Inadequate boiler or feedwater treatment, moderate to heavy scale, etc; or
 - Inadequate shelter or security for the boiler.

1.9 Coupled boilers

- 1.9.1 In installations where two or more boilers are coupled together, all common piping shall be fitted with a non-return valve and an isolating valve at every boiler as a minimum.

- 1.9.2 Two or more unattended boilers, or two or more limited- attendance boilers, may be coupled to a common steam main provided that every individual boiler complies with this code and is capable of independently failing safe.
- 1.9.3 The largest limited-attendance boiler in a coupled installation governs the manning requirements for that installation.

1.10 Combustion

- 1.10.1 The requirements in this code apply to all types of boiler. Where there are fuels other than coal, oil or gas, such as wood chips or refuse, or where special firing conditions apply, then consideration shall be given to the special combustion needs, to ensure that the intent behind this code is met.
- 1.10.2 Continuous flame supervision (self-checking flame scanners) shall be fitted to all gas fired boilers in excess of 1.2 MW to prevent injury through fire side explosions. Ionisation rod flame monitoring is considered to be self-checking. Flame monitors that self-check on flame establishment only are not considered to be self-checking.
- 1.10.3 *Purging.* The controls shall incorporate a purge period immediately before the ignition period. This period shall be to the relevant code in Appendix A, or to the manufacturer's recommendations, but the volume of purge air shall be at least 5 times the volume of the combustion and gas path space in the boiler. Full purging shall be completed before ignition starts.
- 1.10.4 Gas-fired burners and controls shall comply with NZS 5261 or to the relevant ANSI/NFPA standard. See also Appendix A of this code.
- 1.10.5 Burners shall be tuned with proper consideration to oxygen trim and carbon monoxide monitoring. With excess carbon monoxide remaining after combustion, besides being inefficient, there is a danger of explosion. Permanent carbon monoxide monitoring may be necessary in some installations.
- 1.10.6 In oil-burning installations, a pressure-monitoring device shall be installed to lock out the firing system if the oil pressure is less than the pressure required for atomisation.
- 1.10.7 Other requirements relating to combustion equipment for fuel-fired boilers not covered by the above clauses shall comply with AS 2593 or with the relevant ANSI/NFPA Standard. See also Appendix A of this code.
- 1.10.8 For boiler flue systems refer to AS 3892 - *Pressure equipment - Installation*, clause 4.12 "Boiler Flue Gas Exhaust Systems".

1.11 General design requirements

1.11.1 *Seismic requirements*

The boiler shall be designed to additionally include the following seismic requirements:

- 1.11.1.1 During the design of *water tube boilers*, in addition to any other requirement of AS 1228, BS 1113 or ASME I, particular attention shall be given to the following:

- (a) The boiler and all its components, including in particular the supports and the boiler drums and headers in the general region of the supports, shall be designed to additionally include the seismic provisions of NZS 4203. With such forces applying in any horizontal direction, and the boiler at design pressure and temperature, the limiting stresses permitted by the applicable design standard or code shall not be exceeded;
- (b) These seismic provisions shall be regarded as minimum criteria for boilers intended for installation at approximately ground level on approved foundations;
- (c) Where a boiler is intended for general approval and installation anywhere in New Zealand, the seismic requirements for Zone Factor $Z = 1.2$ shall apply. (Refer NZS 4203);
- (d) Where a boiler is designed for a specified location, the seismic requirements for that location shall apply. However, the value of the seismic design coefficient for water tube package boilers shall in no case be less than 0.6;
- (e) The value of the seismic design coefficient shall in no case be less than:

Table 1.1 Seismic design coefficients

Zone factor Z	Minimum coefficient
1.2	0.60
1.1	0.57
1.0	0.53
0.9	0.50
0.8	0.47
0.7	0.43
0.6	0.40

- (f) With the seismic forces applying in any horizontal direction, and the boiler at design pressure and temperature with the contents at normal water level, the limiting stresses permitted by the applicable design document or standard shall not be exceeded. Any respective wind loading need not be considered simultaneously with the seismic case (refer to NZS 4203);
- (g) The greater seismic loading as derived from the above zone values and analyses to NZS 4203 shall be used. These minimum coefficients refer to the Serviceability Limit State for pressure containment and the Ultimate Limit State for foundation design. For pressure equipment installed at ground level, the minimum coefficients will always be greater than the NZS 4203 requirements; and

NOTE: The use of the seismic factors to determine the adequacy of the boiler supports, drums and headers in the region of the supports have been applied for many years and apply to all boiler designs for New Zealand.

- (h) The design and construction of equipment foundations are required to be certified by a Chartered Professional Engineer holding qualifications in an appropriate discipline. This requirement also applies to a building support structure where equipment is to be installed in an elevated position.

- 1.11.1.2 During the design of *shell boilers*, in addition to any other requirement of AS 1228 or BS 2790, particular attention shall be given to ensure that boiler as a whole, including in particular the supports and the boiler shell in the general region of the supports, is designed to additionally include the seismic provisions of NZS 4203. These seismic provisions shall be regarded as minimum criteria for boilers intended for installation at approximately ground level, and in such cases the value of the seismic design coefficient shall in no case be less than 0.6 with reference to the Serviceability Limit State defined in NZS 4203. With such forces applying in any horizontal direction, and the boiler at design pressure and temperature, the limiting stresses permitted by AS 1228 and BS 2790 shall not be exceeded.
- 1.11.1.3 Special consideration shall be given to boilers installed in elevated locations, or to components which, because of the size of the boiler, are installed at a significant height above ground level.
- 1.11.1.4 All boilers shall be adequately restrained, allowing for thermal expansion, to prevent excessive movement and damage to connected systems during seismic disturbances.
- 1.11.1.5 Boilers shall not be relocated in a seismic zone which has a higher seismic coefficient than the one for which they were approved, without design verification of their suitability.

1.11.2 Construction materials

- 1.11.2.1 Materials for boilers, intended for their use in New Zealand, shall comply with the requirements of the relevant design standard listed in Appendix A and other requirements of this code.
- 1.11.2.2 Alternative materials may be used provided they are selected in accordance with the requirements of the relevant design standards and this code.

1.11.3 Design of boilers

- 1.11.3.1 New fired, hot water and waste heat boilers, or alterations to existing boilers, shall be designed in accordance with the requirements of the relevant design standard, listed in Appendix A and the requirements of this code.
- 1.11.3.2 Boilers and their support structures shall be designed for loads including seismic, wind and snow loading in accordance with the relevant standard (see Appendix A) and the requirements of this code.
- 1.11.3.3 Any software used in the process of boiler design including updates, should be validated and approved for its use. Updated versions of such software should also be validated and approved, and the software application manual should be available for reference. Access to programmes should be controlled by password or by other suitable means preventing unauthorised access. Programme coding should be protected against unauthorised and inadvertent changes. Data files should be regularly backed up and copies securely archived so that simultaneous loss of the working data file and backup will not occur.
- 1.11.3.4 The design life of boilers or any of their parts, if applicable, shall be determined in accordance with the relevant design standard. The design life shall be specified in quantitative terms and details shall be included in the operating and maintenance instructions provided for that equipment. Any parts subject to design lifetime

limits shall be clearly identified by the designer at the time of submitting an application for design verification.

- 1.11.3.5 Australian standard AS 4343 and Appendix G of this code shall be used to determine the hazard level classification and the corresponding design verification and fabrication inspection requirements for boilers.
- 1.11.3.6 Water tube boilers designed to the ASME Boiler and Pressure Vessel Code, section I shall, as a supplementary requirement, comply with the following:
- (a) Materials shall conform by manufacturing specification and documentation with those materials listed in table 1A of section II, part D of the ASME Code;
 - (b) The methods of stress analysis used shall conform with those methods of analysis detailed in BS 1113 and with the maximum allowable stress limits of table 1A of section II, part D applying for the appropriate material and temperature; and
 - (c) Gauges, fittings and valves, other than safety valves, shall be equivalent to or conform with BS 759.

1.11.4 Design verification

- 1.11.4.1 New boilers, as well as alterations and repairs to existing boiler installations, shall be designed and design verified in accordance with the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999, as provided in this code. See also Appendix G of this code.
- 1.11.4.2 The design verification requirements for boilers intended for use in New Zealand shall be in accordance with hazard level determination in AS 4343 *Pressure equipment - Hazard levels* and Appendix G of this code.
- 1.11.4.3 Inspection bodies providing design verification services, design verifiers and design verification shall conform with the requirements of the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999, as provided in this code.
- 1.11.4.4 Any software used in the process of design verification of boilers shall be validated and approved for its use. Updated versions of such software shall also be validated and approved, and the software application manual shall be available for reference. Access to programmes shall be controlled by password or by other suitable means preventing unauthorised access. Programme coding shall be protected against unauthorised and inadvertent changes. Data files shall be regularly backed up and copies securely archived so that simultaneous loss of the working data file and backup will not occur.

1.11.5 Tube plate temperatures in shell steam boilers

- 1.11.5.1 The designer shall designate the maximum value for the gas temperature at the tube entry to the first pass from the combustion chamber and shall undertake the tube plate design based on this value.
- 1.11.5.2 Shell boilers that are being upgraded to unattended or limited-attendance mode, and that do not have a designated maximum value for the gas temperature, shall have this value determined by reference to the latest edition of BS 2790. Pre-1982 boilers shall have the maximum value for the gas temperature determined in accordance with the latest version of BS 2790, irrespective of whether they have

an existing maximum designated temperature. This calculation shall be submitted to an inspection body for design verification.

- 1.11.5.3 The boiler manufacturer shall demonstrate that the value, specified in 1.11.5.1, is not exceeded during commissioning tests with the boiler at full load under maximum firing conditions by use of an accurately calibrated multishield high-velocity suction pyrometer. A permanent access point shall be provided for such a pyrometer. The manufacturer shall ensure that the controller understands the importance of regularly checking the combustion chamber temperature and knows the maximum safe value. Alternatively, the combustion chamber temperature may be measured by a bare combustion chamber thermocouple and the cut-out temperature shall be set 300°C below the specified maximum value in clause 1.11.5.1.
- 1.11.5.4 The tests referred to in clause 1.11.5.3 shall be carried out during commissioning of the thermocouple and temperature controller, with the boiler operating at full load under maximum firing conditions. This should be done at five-yearly intervals thereafter and whenever either the thermocouple or temperature controller is replaced. The combustion chamber gas temperature measured shall be recorded.
- 1.11.5.5 The controller shall ensure that the specified maximum temperature is not exceeded through changes in fuels, firing methods or deposits on the gas or water side of heating surfaces which could reduce heat transfer rates and so increase gas temperatures.

NOTE: A pyrometer reading should be made whenever a significant change is made to firing rate, firing method or fuel used.

- 1.1 1.5.6 The requirements of this section are waived for small boilers.

1.12 Manufacture and workmanship

- 1.12.1 Manufacture and workmanship of boilers and their modifications shall be in accordance with the requirements of the relevant design standard and this code.
- 1.12.2 The manufacturer shall ensure that a nameplate with all details is attached to the boiler such that it is visible on the outside of the cladding for identification purposes.
- 1.12.3 Manufacturers shall complete a "Manufacturer's Data Report" for boilers in accordance with the requirements of the manufacturing standard.

1.13 Fittings

- 1.13.1 All valves, fittings and mountings shall comply with the standards designated in Appendix A of this code, or to an appropriate national standard approved by an inspection body or a classification society, and shall be specifically rated for the temperature and pressure conditions of the boiler plant.
- 1.13.2 Associated pipework, flanges, joint materials, etc. shall be of an appropriate type, complying with the standards designated in Appendix A of this code.
- 1.13.3 The bore of pipes connecting water level gauges, safety controls or alarm devices to the boiler shall not be less than 25 mm, and they shall be as short as practicable.

This does not necessarily apply to once-through coil boilers, electrode boilers or to small boilers.

1.14 Water level gauges

1.14.1 With certain exceptions, every steam boiler shall have at least two independent means of indicating the water level, each capable of being isolated from the boiler and both of which shall be water level gauges in which the water level can be observed. The exceptions are:

- (a) Once-through coil boilers;
- (b) Certain electrode boilers;
- (c) Boilers of less than 100 kW output (145 kg/h evaporative capacity), where one water level gauge is sufficient;
- (d) In certain cases, two approved alternative devices, which indicate water level, may be used in place of one of the two required water level gauges; or
- (e) In appropriate cases, mainly for high-pressure applications, approved alternative remote water level indicators may be used (see 1.14.7).

NOTE: For each application of subclauses (d) or (e) above, a case shall be made to the satisfaction of an inspection body involved with design verification of the proposed boiler installation. Each case shall include documentary data and/or certificates from bodies of international repute supporting the choice of the proposed alternative and reasons for not using water level gauges. Each of these cases shall be considered for approval on its own merits.

1.14.2 The water level gauges, with isolating valves or cocks, shall be connected directly to the boiler and no outlet or other connections, except a drain for the gauge glass, shall be attached to the water gauge or to the pipes connecting the water gauge to the boiler.

1.14.3 Tubular-type water gauges shall be fitted with safety balls on both the steam and water side. Tubular-type water gauges are not recommended for unattended boilers with a design pressure exceeding 1100 kPa.

1.14.4 Tubular-type water level gauges shall be fitted with protective guards satisfactory to the equipment inspector.

1.14.5 The required gauge in which the water level can be directly observed shall be mounted so that all operational water levels such as feed pump start and stop (or full flow and stop), the lowest lock-out and alarm level and the high level cut-out take place with the water still visible in the gauge glass.

1.14.6 *Lowest alarm level*

1.14.6.1 For *water tube boilers*, the lowest alarm level shall be at least 100 mm above the lowest water level at which there will be no danger of over heating any part of the boiler when in operation at that level.

1.14.6.2 For *shell boilers*, the lowest alarm level shall be at the greater of either:

- (a) 100 mm above the highest heated surface; or

- (b) A height which will give a sufficient volume of water above the highest heated surface to allow a sinking time of not less than 5 minutes, or 7 minutes for solid fuel boilers. This sinking time is the time for the water to fall from the lowest alarm level to the level of the highest heated surface, at a steam generation rate equal to the maximum capacity of the boiler with no feedwater being supplied.

1.14.7 Remote level indicators

- 1.14.7.1 Where all the drum safety valves are set to discharge at or above 6200 kPa, two independent remote water level indicators may be provided instead of one of the two required gauge glasses, to indicate the drum water level.
- 1.14.7.2 Where the operator, at the main control point for the boiler, is unable to read the gauge glass water level, two dependable indirect and totally independent indications shall be provided, either by transmission of the gauge glass image or by remote level indicators. This does not apply to unattended boilers.

1.14.8 Alarms

Water level gauges, or alternative devices, where approved, shall not be used to initiate alarms.

1.15 Safety valves

- 1.15.1 Safety valves shall comply with BS 6759 or an equivalent standard acceptable to an inspection body. Controllers responsible for safety valves shall ensure that records for safety valves are maintained in accordance with the requirements of AS/NZS 3788. Servicing, maintenance, testing and inspection of safety valves shall be carried out by either an organisation having a certified quality management system, specifically assessed and registered (accredited, in the case of testing and/or inspection) for these services, or within an approved management system maintained by the controller. Such approved management system shall be appropriate for the type of installation and can be either a quality management system, specifically assessed and certified for such services, or a controller's management system approved by an inspection body. Where safety valves are maintained within a controller's approved management system, they shall be inspected, tested and issued with a certificate of inspection by an inspection body

NOTE: Controllers can choose to delegate this responsibility to a servicing organisation, operating under a certified quality management system of an appropriate scope. An inspection body shall still be engaged and shall issue safety valves and/or the complete boiler with appropriate certificates of inspection.

- 1.15.2 A steam boiler of more than 2.3 MW output (3 700 kg/in evaporative capacity) shall be fitted with not less than two single-safety valves or one double-safety valve. Every superheater and every economiser that is capable of being isolated shall have at least one safety valve on the outlet side.

NOTE: This also applies to reheaters, where safety valves are installed.

1.15.3 Discharge capacity

- 1.15.3.1 The total rated discharge capacity of all the safety valves mounted on the boiler (and integral superheater) calculated in accordance with BS 6759: Part 1 (or equivalent) shall be at least equal to the maximum evaporative capacity of the boiler. Where the feedwater temperature, and hence the actual evaporative capacity of the boiler is not known, the installed safety valve capacity shall be 115% of the specific peak load evaporation "from and at 100°C".
- 1.15.3.2 The maximum evaporative capacity of the boiler shall be discharged without causing the boiler pressure to increase to more than 10% above the safe working pressure.

1.15.4 Accumulation test

- 1.15.4.1 An accumulation test on the boiler valve(s) to verify the total discharge capacity shall be carried out when a new boiler is commissioned, when a different type or size of valve is fitted, when the type of fuel is changed, when output conditions are changed, or when otherwise considered necessary, and shall be witnessed by an equipment inspector before the boiler is put into normal operation. This test shall be carried out at the maximum evaporative capacity with the stop valve closed, to demonstrate the full rated discharge capacity.
- 1.15.4.2 During this test, no more feedwater shall be supplied than is necessary to maintain a safe working water level. Tests with the stop valve closed should not be carried out on boilers fitted with superheaters or reheaters where overheating may occur, and special consideration shall be given to boilers fired with solid fuels.

1.15.5 Sizing of safety valves

- 1.15.5.1 All steam boiler safety valves shall be sized according to BS 1113 or BS 2790, as appropriate, or, for boilers designed to other approved codes (see Appendix A of this code) according to the rules of those codes.
- 1.15.5.2 All hot water boiler safety valves shall be sized according to clause 8.8 of this code.

1.15.6 Superheater

For boilers fitted with superheaters, safety valves used shall have a guaranteed throughput at the design conditions, and it shall be demonstrated by flowmeter tests that this is in accordance with the design standard used. Documentation from the manufacturer detailing the safety valve tests shall be made available to the inspection body.

1.16 Pressure gauge

- 1.16.1 Every boiler shall be fitted with at least one pressure gauge of the bourdon tube type complying with BS 759: Part 1, or equivalent, indicating the internal pressure of the boiler. The diameter of the pressure gauge shall be at least 150mm, although for small boilers this may be reduced to 100 mm. Every gauge shall have appropriately marked the maximum working pressure of the boiler.
- 1.16.2 A calibrated pressure gauge shall be used to set the safety valves. This gauge shall be checked and calibrated at intervals not exceeding 12 months by a laboratory accredited by IANZ for the testing and calibrating of pressure gauges.

1.16.3 A test point shall be provided on the pressure gauge connection.

1.17 Blowdown arrangement

1.17.1 All boilers shall be fitted with blowdown valves which shall comply, for shell boilers with BS 2790, for water tube boilers with BS 1113, or for boilers designed to other approved codes (see Appendix A of this code) according to the rules of those codes.

1.17.2 A maximum temperature (as required by the local authority) shall apply to water discharged into sewerage or drainage systems. Drains and piping subject to discharge shall discharge to safe areas and not cause unacceptable degradation to the environment. The blowdown system shall have adequate volumetric and thermal capacity and large-diameter vent pipes to be able to cool down the contents under the continuous flow and to avoid pressurisation of the lines or, if fitted, the blowdown tank. Any system used shall meet local authority requirements. The guidelines for safe design of boiler blowdown systems are outlined in the HSE Guidance Note PM 60; *Steam boiler blowdown systems*.

1.18 Water treatment

1.18.1 Boiler feedwater and boiler water shall be treated and maintained in accordance with the boiler water treatment company's recommendations. Regular blowing down will not prevent scale formation if the feedwater is untreated, and therefore external treatment plant and/or suitable conditioning chemicals shall be incorporated into the system. Regular blowdown, testing and monitoring of the feed and boiler water shall be carried out and the necessary records kept (refer to clause 1.26). Additional external test requirements for limited-attendance and unattended boiler waters are given in clauses 3.16 and 5.17 respectively.

1.18.2 With correct water treatment, and the application of correct monitoring procedures, the problems of scale formation and foaming should not arise.

1.18.3 Controllers who use acid cleaning methods to remove scale shall ensure that the operation is fully controlled by trained and experienced persons.

1.18.4 Controllers employing longer term chemical removal of scale shall open the boiler up at frequent intervals, as recommended by the boiler chemical company, to check on the condition of the boiler.

1.19 Feed pumps

1.19.1 All new boilers exceeding 1.2 MW power output (except coil boilers: see clause 6.3) shall be served by at least two feed pumps.

1.19.2 Where boilers are individually served by a dedicated set of feed pumps, except for certain large industrial plant where the industry practice dictates otherwise, the total feed pump capacity shall be not less than 240% of the amount of water required to generate steam at the output of the boiler calculated on the basis of feedwater at 100°C and with the boiler at design pressure.

1.19.3 Where the feed pumps supply more than one boiler, the system shall be such that under all combinations of feed water supply and steam demand, there shall be at

least two feed pumps available for service, and the installed feed pump capacity shall be at least 120% of the maximum feed water demand from the combined boiler plant plus sufficient reserve feed pump capacity to cover any pump failure.

- 1.19.4 The feed pumps shall be capable of responding automatically to changes in feedwater demand.
- 1.19.5 Boilers fitted with a water circulation pump shall have an interlock to prevent firing if the water flow is not established and maintained.
- 1.19.6 Section 1.19 does not apply to once-through forced circulation coil boilers, neither does it apply to installations with outputs greater than 20 MW.

1.20 Feedwater systems

- 1.20.1 All unattended and limited-attendance boilers shall be fitted with an automatic means of maintaining the feedwater flow within the limits specified by the boiler designer.
- 1.20.2 Boilers exceeding 3 MW capacity shall be fitted with continuous modulating feedwater systems.
- 1.20.3 Make up feed from mains water supply shall incorporate back flow prevention as required under the Building Act 1991 and local authority requirements.

1.21 Electrical equipment and supply

- 1.21.1 Electrical equipment and supply shall comply with the New Zealand Electricity Regulations and relevant codes of practice.
- 1.21.2 Every boiler shall have a main isolator or emergency stop switch, which shuts down the burner but allows alarms to operate. This shall be adjacent to the normal boiler house access and shall be clearly labelled. The main isolator or emergency stop switch shall be capable of both being locked in the open position, and closed only by manual means. Over 20 MW boilers may have an alternative arrangement.
- 1.21.3 The reset facility shall be located in the vicinity of the boiler or the main control point, so that it may be easily verified that the situation that demanded the isolation of the boiler has been rectified, and the boiler is safe to start.
- 1.21.4 The boiler and its combustion and control equipment shall be designed and constructed so that loss of electric power, or loss of a phase to the boiler control system, at any time shall, in the absence of a backup power supply, cause a shutdown to a safe condition.
- 1.21.5 The combustion chamber, bed or grate system shall be designed and operated to minimise the stored energy in the system upon power failure. Alternatively, these systems can be designed to withstand the effects of the remaining stored energy without risk of overheating.
- 1.21.6 Where a potential hazard may exist, e.g. where the combustion chamber is substantially refractory lined, a type test shall be performed by the manufacturer to the satisfaction of an equipment inspector to ensure that the boiler complies with these requirements.

- 1.21.7 Restarting on restoration of the mains supply is subject to the same requirements as normal start-up for oil and gas burners. Start-up for solid fuel burners will depend on the system installed. Interruption and subsequent restoration of the electricity supply shall not override any uncorrected fault condition which existed prior to the mains supply failure or interruption. Uncorrected faults shall be indicated on restoration of power.
- 1.21.8 The manufacturer shall make sure that all cabling for the boiler control system is installed with due regard for temperature conditions. All wiring in situations where it could contact the boiler casing, or be subjected to heat in normal operation, shall have appropriate high-temperature insulation. A number of problems have arisen where an incorrect grade of wiring has been installed in flexible conduit, which has been allowed to touch the boiler casing.

1.22 Control components

- 1.22.1 Every component of the boiler control system shall operate reliably and safely within the temperature and humidity limits specified by the manufacturer. The lower temperature limit shall be 0°C or less and the higher temperature limit shall be at least 50°C.
- 1.22.2 Control components will be acceptable with a statement from the component manufacturer that they comply with a recognised applicable standard.
- 1.22.3 Boiler safety controls shall be contained in secure, tamper-proof, dustproof and splash-proof cabinets. The designer shall ensure that component temperature limits will not be exceeded. These shall be sealed or locked, with the key in the charge of a responsible person in the organisation. Where the boiler controls are integrated with the process controls or for boilers greater than 20 MW, arrangements shall be made to meet the intent of this sub-clause.
- 1.22.4 Boiler safety controls shall be of a type accepted by an inspection body or a classification society.
- 1.22.5 Any alterations to the boiler or the boiler control system shall be authorised by the boiler manufacturer and/or the equipment inspector, and shall be clearly documented. Any conformity assessment activities in relation to these alterations shall be done as per table G1 in Appendix G of this code.
- 1.22.6 Where necessary for the safe operation of the plant, power-operated valves shall move immediately to a safe condition on power failure, or when de-energised, or on failure of the actuating medium.
- 1.22.7 For internally mounted boiler controls, any failure of the system shall cause the burner to shut down and lock out.
- 1.22.8 The signals transmitted by electronic safety equipment need to be verified as falling between certain strength levels. Where signals fall outside these strength levels, the controls shall recognise a system failure rather than an operation failure, and take appropriate action.

1.23 Fault alarms and lock-outs

- 1.23.1 The first low water safety lock-out and alarm system may be incorporated into the automatic water level controller.

- 1.23.2 All faults affecting the safety of the plant shall initiate an audible and visual alarm.
- 1.23.3 In addition, all faults causing the risk of an unsafe condition shall also lock out the firing system. Flame-on signal should be provided.
- 1.23.4 Alarms shall be provided at points where they can be seen and/or heard by persons who are able to take appropriate action. The presence of unrectified faults is to be clearly indicated at all times.
- 1.23.5 If arrangements are made to silence audible alarms, they are not to extinguish visual alarms. The muting of alarms shall be clearly indicated.
- 1.23.6 Alarms associated with the boiler and steam plant shall be clearly distinguishable from other alarms, and shall be clearly identified.
- 1.23.7 Where alarms are displayed as group alarms, provision is to be made to identify individual alarms at the main control station (if fitted) or alternatively at subsidiary control stations.
- 1.23.8 Acknowledgement of visual alarms is to be clearly indicated.
- 1.23.9 Acknowledgement of alarms at positions outside a boiler house, or away from the boiler control position, shall neither silence the audible alarm nor extinguish the visual alarm in that boiler house or control position.
- 1.23.10 In cases where an alarm has been acknowledged and that alarm condition has shut down the boiler, a subsequent alarm condition need not activate an audible alarm (as the boiler is already shut down). In cases where an acknowledged alarm condition has not resulted in shut down of the boiler, a subsequent alarm condition shall activate the audible alarm. Visual alarms shall be activated in all cases.
- 1.23.11 For the detection of transient faults which are subsequently self-correcting, alarms are required to lock in until accepted.
- 1.23.12 The alarm system and all alarms shall be provided with test functions and are to be capable of being tested during normal boiler operation or start-up sequence.
- 1.23.13 The alarm system is to be designed as far as is practicable to function independently of control and safety systems such that a failure or malfunction in these systems will not prevent the alarm from operating. Water level alarms shall not be connected to water level gauges, or alternative devices as in 1.14.1(e).
- 1.23.14 When alarm systems are provided with means to adjust their set point, the arrangements are to be such that the final settings can be readily identified (possibly by a tag) and, where possible, the settings sealed, locked or password protected.
- 1.23.15 For shell-type steam boilers, an alarm shall be provided to warn when the gas temperature at the tube entry to the first pass from the combustion chamber approaches the maximum temperature designated by the manufacturer. This alarm shall be set by the manufacturer to some limit below this maximum temperature.
- 1.23.16 Specific details of all major events causing the alarms to operate shall be recorded in the boiler room log book, except where they are automatically recorded by a continuous data recorder.

1.23.17 Remote alarms and paging systems may be used when desired, in addition to the above.

1.23.18 All alarms shall indicate the control which has been activated.

1.24 Testing of controls and alarms

1.24.1 At no time during a test of the water level controls should the water be lowered to the extent that it disappears from the gauge glass.

1.24.2 Specific details relating to the testing of the controls and alarms shall be entered in the boiler room log book, except where they are recorded automatically by a continuous data recorder.

1.24.3 A means of testing visual alarms shall be provided.

1.25 Boiler control systems including programmable logic controller (PLC)

1.25.1 Boiler control systems, including those that are plc-based, should be designed according to the National Fire Protection Association Standards, or equivalent.

1.25.2 All boiler control systems shall be automatically monitored in such a manner that any failure of any component, or system failure of the monitoring device, shall immediately initiate a boiler lock-out. The boiler control system shall indicate the fault initiating the boiler lock-out.

1.25.3 The second low water level lock-out and alarm, flame detector and any forced circulation lock-out shall either:

(a) Be hardwired; or

(b) Utilise a "two out of three" redundancy system, specifically designed to provide a high level of operational integrity and reliability. If such a system is employed it must be either monitored by an independent system capable of initiating alarms, or supplemented by independent hardwired alarms.

1.25.4 The boiler control system, including PLC, shall only be adjusted by persons authorised to do so by the boiler manufacturer or approved maintenance contractor.

1.25.5 Purpose-built electronic controllers such as burner sequence controllers may be used provided they have the appropriate type acceptance. PLC systems should include watch dog timer and non-volatile memory module. The PLC should default to non-volatile memory on memory failure.

1.25.6 Where applicable to PLCs, program coding should be protected against unauthorised and inadvertent changes.

1.26 Documents and marking

1.26.1 Instructions

Operating instructions, including circuit diagrams for the boiler and ancillary steam plant, shall be developed from the manufacturer's recommendations and kept available in the boiler house or at the control position.

1.26.2 Operation log books, etc.

A continuous record shall be kept of the boiler operating conditions. This shall include alarm calls, breakdowns, routine maintenance and testing, boiler water and feedwater testing and treatment and records of the gas temperature checks in the combustion chamber required in 1. 11.5.3. This record shall be signed by the operator or responsible person at the change of every working period, and it shall be made available for audit as required.

1.26.3 Maintenance records

Full records shall be kept of all maintenance and repairs carried out on the boiler and the associated fittings, controls, alarms and pipework. The person responsible for the maintenance shall identify themselves on the record, and these records shall be made available for audit as required.

1.26.4 Alterations and additions

All changes to the boiler structure, the boiler control system and associated equipment or hot water boiler, shall be fully documented with drawings and all relevant data. No changes shall be made to the boiler or the boiler control system without the consent and backing of the boiler manufacturer and/or the equipment inspector.

1.26.5 Retention of records

Records are to be maintained in good and readable condition. Operation records shall be retained for a period of two years. Maintenance records of major or annual overhauls or of major repairs, and records of alterations and additions, shall be retained for the life of the boiler. Routine defect maintenance records shall be retained for five years.

1.26.6 Marking

1.26.6.1 Each boiler and separate type of plant shall be permanently and legibly marked to show its identity and origin, in the manner required by BS 1113 or BS 2790 or the approved design standard. See Appendix A of this code.

1.26.6.2 In addition to this, the attendance category and the period of operational supervision according to the table in this code shall be displayed prominently adjacent to the boiler.

1.27 Duties of controllers

1.27.1 Every controller commencing or setting up or recommencing a business or process which involves the use of a limited-attendance or unattended boiler shall notify the authority in writing prior to operating such a boiler.

- 1.27.2 Every controller shall ensure that equipment is supervised by appropriately qualified or trained persons at all times that the boiler plant is operating.
- 1.27.3 Every controller shall ensure that all persons are adequately protected from potential danger arising from sources of heat, noise and harmful substances or gases. Amongst other codes, OSH has produced the *Approved Code of Practice for the Management of Noise in the Workplace* and the *Approved Code of Practice for the Safe use of Visual Display Units*. These documents should be used for management of health in relation to the equipment covered by this code.
- 1.27.4 Every controller shall ensure that appropriate records (clause 1.26) are kept.
- 1.27.5 Every controller must take all practicable steps to ensure that a boiler or a hot water boiler is operated within its design limits.
- 1.27.6 Every controller shall at all reasonable times furnish the means for an entry, inspection, examination and inquiry or the exercise of any other power prescribed by legislation required by: any member of the authority, or any person specifically delegated by the authority, or an equipment inspector, acting on the instruction of the authority or performing duties in connection with the Certificates of Inspection.
- 1.27.7 Every controller shall provide good access to the boiler and its fittings and devices, such as are necessary for the safe operation and maintenance of the boiler.

1.28 Maintenance

- 1.28.1 The controller shall set in place procedures which ensure that maintenance is carried out as set out in table 1.3. These procedures should include the boiler manufacturer's recommendations and shall ensure that the boiler remains in good and safe condition at all times.
- 1.28.2 *Periodic maintenance to the boiler valves, gauge glasses, fittings, etc.*
 - 1.28.2.1 Maintenance of these items shall be carried out by an appropriately trained and experienced person.
 - 1.28.2.2 Coupled boilers shall be effectively isolated before any persons enter them for inspection or maintenance.
- 1.28.3 *Maintenance system*
 - 1.28.3.1 For limited-attendance and unattended boilers operated under a quality management system, this system shall embrace all aspects of maintenance, including outside contractors, maintenance records and the treatment of the boiler feedwater and boiler water. This maintenance system shall be certified to AS/NZS ISO 9001:2000.
 - 1.28.3.2 For limited-attendance and unattended boilers not operated under a quality management system, the equipment inspector shall verify the maintenance records and the boiler water and feedwater records of the controller.
 - 1.28.3.3 For all other boilers, the equipment inspector shall verify the maintenance records.

1.29 Inspection and testing

1.29.1 New boilers shall undergo a conformity assessment procedure in accordance with the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999, as provided in this code.

New boiler installations shall be manufactured, installed and commissioned in accordance with the relevant construction standard(s) listed in Appendix A of this code.

1.29.2 The fabrication inspection requirements for boilers intended for their use in New Zealand shall be determined in accordance with the hazard level determination in *AS 4343 Pressure equipment - Hazard levels* and Appendix G of this code.

1.29.3 In-service boilers shall be inspected and tested in accordance with the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999, AS/NZS 3788 and other relevant requirements of this code. The equipment inspector may vary the inspection procedure described in Appendix F of AS/NZS 3788 to suit the requirements of a particular boiler installation.

1.29.4 Inspection periods for in-service boilers shall be in accordance with AS/NZS 3788 except as modified by table 1.2 below, other requirements of this code or a Gazette Notice of the New Zealand Government.

Table 1.2: In-service inspection periods for boilers and hot water boilers

1	2	3	4	5	6
Pressure equipment	Commissioning inspection required?	First yearly inspection required?	Inspection period (years)		
			External inspection period	Internal Inspection	
				Nominal period	Extended period
Chemical recovery boilers	Yes	Yes	1	1	1
Hot water boilers	Yes	Yes	2	2	4
Unfired waste heat boilers	Yes	Yes	1	1	4
Deaerators	Yes	Yes	1	1	4

NOTE: In addition to the applicable requirements of AS/NZS 3788 and Table 1.2 above, the following equipment does not require a Certificate of Inspection, but needs the appointment of a responsible person:

Boilers that generate steam by heat transfer in a continuous coil where:

- (a) The total combined volumes of the steam separator, the steam drum and the steam and water drum do not exceed 10 litres water capacity; and
- (b) The effective heating surface of the boiler does not exceed 7.5 m² in area.

Model boilers that:

- (a) Have a maximum water capacity of 1 litre; and
- (b) Are used as toys.

Model boilers that:

- (a) Have a maximum water capacity of 50 litres; and
- (b) Are designed and used by members of model clubs that are incorporated societies.

Hot water boilers with outputs not exceeding 1.5 MW.

- 1.29.5 The inspection periods for in-service boilers in columns 4 and 5, table 4.1 of AS/NZS 3788 and table 1.2 above are maximum nominal periods. Inspection periods up to these nominal periods may be set where:
- (a) The controller is satisfied that the period would be safe;
 - (b) There is relevant operating experience with the equipment;
 - (c) Suitable records, in accordance with AS/NZS 3788, are available for that equipment; and
 - (d) The equipment inspector approves the inspection period.
- 1.29.6 The boiler shall be shut down and prepared for inspection in accordance with the instructions of the equipment inspector. This preparation may include cleaning combustion spaces and removal of refractory, opening up, stripping down and laying out of boiler fittings and ancillary equipment. The interior of the boiler shall be inspected, unless the equipment inspector is satisfied that such interior inspection is not necessary in the circumstances. The boiler shall be subsequently inspected, tested, and the safety valves set whilst in operation.
- 1.29.7 Inspection periods may only be extended beyond those in columns 4 and 5, table 4.1 of AS/NZS 3788 and table 1.2 above, where these have been approved by the Secretary in writing, pursuant to the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999. The procedure for obtaining approval of extended inspection periods for pressure equipment is given in Appendix F, of the *Approved Code of Practice for Pressure Equipment (Excluding Boilers)*.
- 1.29.8 Where the type of fuel used in a boiler is changed, then an inspection period will not be extended, as provided in 1.29.7, unless the Secretary is satisfied that operating experience subsequent to the change has demonstrated that such an extension would be safe.
- 1.29.9 Inspection bodies providing equipment inspection services and equipment inspectors shall conform with the requirements of the HSE (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999.
- 1.29.10 Boiler safety valves shall be inspected and tested in accordance with clause 1.15.

1.30 Security and protection

- 1.30.1 Boilers shall be installed in such a manner as to ensure that the boiler, its fittings, controls and ancillary equipment cannot be tampered with by unauthorised persons.
- 1.30.2 Adequate protection shall be provided against the weather and the ingress of moisture and dust.

Table 1.3: Criteria for type, capacity and associated supervision and maintenance for attended, limited attendance and unattended boilers

Attendance category	Boiler types	Capacity ¹	Notes	Operational supervision		Maintenance		
				By	When	How	By	When
ATTENDED OPERATION	All types	<=20MW	Special conditions apply for manning, controls and alarms	Qualified Operator	Continuously ²	Normal boiler checks and logging of results	A responsible and experienced person	Manufacturer's recommendations but at least every 3 months
		>20MW						
LIMITED ATTENDANCE OPERATION	Water-tube steam boilers and hot water boilers with a steam or gas head for pressurisation	>6MW	Formal ISO 9000 series standards Quality Management System to apply	Qualified Operator	4-hourly intervals max	Normal boiler checks and logging of results	Approved maintenance contractor ³	Manufacturer's recommendations but at least every 3 months
		<=6MW	Quality Management System to apply (see 1.31) or operation and management system	Qualified Operator	8-hourly intervals max			
		max pressure 17bar						
UNATTENDED OPERATION	Water-tube steam boilers and hot water boilers with a steam or gas head for pressurisation	No limit	An ISO 9000 series Quality Management System to apply	Responsible person	24-hourly intervals max	Normal boiler checks and either logging of results every 24 hours or data logger printout	Approved maintenance contractor ³	Manufacturer's recommendations but at least every 3 months
		<=6MW	Quality Management System to apply (see 1.31) or operation and management system					
		Max pressure 17bar						
		Existing >1.2MW						
UNDER 15HP SHELL BOILERS	Not suitable to be upgraded (clause 1.2 and 1.7)	New >3MW	Only run under existing conditions. Not suitable for upgrading to limited attendance or unattended operation	Responsible person	2-hourly intervals max	Normal boiler checks and logging of results	A responsible and experienced person	Manufacturer's recommendations but at least every 3 months
		Existing >1.2MW						
		Max pressure 17bar						
		<=14.9HP (1.2MW)						
		Max pressure 17bar						
ONCE THROUGH FORCED CIRCULATION COIL BOILERS	Suitable to be upgraded (clause 1.2 and 1.7)	Existing	May be upgraded to unattended operation	Responsible person	Intervals as authorised following upgrade	Normal boiler checks and logging of results	Approved maintenance contractor ³	Manufacturer's recommendations but at least every 3 months
		New						
		<=14.9HP (1.2MW)						
		Max pressure 17bar						
ONCE THROUGH FORCED CIRCULATION COIL BOILERS	Existing and new	<=3MW	Full compliance with this code of practice	Responsible person	Continuously ²	Normal boiler checks and logging of results	Approved maintenance contractor ³	Manufacturer's recommendations
		All other coil boilers	Full compliance with this code of practice					

Table 1.3 continued

Attendance category	Boiler types	Capacity ¹	Notes	Operational supervision		Maintenance	
				By	When	How	By
SMALL BOILERS	P max = 10bar V max = 1500litres	<500kW	Special considerations apply for controls and instruments	Responsible person			Manufacturer's recommendations but at least every 3 months
PRESSURISED HOT WATER BOILERS	Fully-flooded hot water boilers	No upper limit. Operating above 100°C and 200kPag		Responsible person	As appropriate	Normal boiler checks and logging of results	A responsible and experienced person
UNFIRED WASTE HEAT BOILERS and HRSG (Heat recovery steam generators)	Water tube or shell	No limit	Controls as per this code	Responsible person	4-hourly max	Normal boiler checks and logging of results	Approved maintenance contractor ³ Manufacturer's recommendations

Notes:

1. Capacity denotes maximum power output that can be derived from the boiler.
2. Not necessarily continuous, but sufficiently frequent to ensure that the attendant will observe and take action in as short a time as possible on any malfunction or change in conditions that may occur.
3. See Clause 1.4 Definitions. A permitted partial exception is given in 1.28.2.1.

1.31 Quality management system for boilers

- 1.31.1 Unattended and limited-attendance boilers shall be operated within a quality management system, except as provided for herein.
- 1.31.2 For new installations, a period of time not exceeding one year will be allowed during which the unattended or limited-attendance boiler may be operated while the quality management system is being established.
- 1.31.3 Unattended and limited-attendance steam installations with one boiler or multiple coupled boilers with a rating (combined rating for multiple boilers) larger than 6 MW will require the boiler quality management system to be certified.
- 1.31.4 Unattended and limited-attendance steam installations with one boiler or multiple coupled boilers with a rating (combined rating for multiple boilers) smaller than or equal to 6 MW will require either:
 - (a) A documented boiler operation and maintenance management system approved and audited annually by an inspection body; or
 - (b) A boiler quality management system, audited and certified to AS/NZS ISO 9001:2000 by a certification body.
- 1.31.5 The equipment inspector will verify the maintenance records of all other boilers.
- 1.31.6 It is recommended that the larger attended boiler installations should be operated within a documented and certified AS/NZS ISO 9001:2000 Quality Management System.
- 1.31.7 Every certified QMS must be based on AS/NZS ISO 9001:2000.

1.32 System auditing/monitoring

- 1.32.1 Adequate provision shall be made for the regular and frequent monitoring of the boiler quality management system or the boiler operating and maintenance system.
- 1.32.2 Audits of the boiler operating and maintenance system shall be carried out at regular intervals (at least twice-yearly) by persons with a technical background trained in auditing procedures and not directly involved with the routine operation of that boiler.
- 1.32.3 The authority will carry out its own audits of boiler operating and maintenance systems, in addition to the above requirements.

1.33 Method of application for limited attendance and unattended boilers operation

- 1.33.1 The HSE (PECPR) Regulations 1999 require that boilers that meet the requirements specified for limited attendance or unattended boilers shall be notified by the Controller to the Authority prior to first operation. The information sought in this notification is given in section C1 of appendix C.
- 1.33.2 On proof of compliance with the requirements of appendix C, an exemption will be granted by the Authority under section 37(3) of the Boilers, Lifts and Cranes

Act 1950 (until such time as it is repealed) to operate a boiler in limited attendance or unattended mode.

1.34 Importers, distributors and resellers

Every person supplying boilers that have been manufactured overseas, or within New Zealand, shall ensure that before such equipment is put into operation, or sold, or otherwise transferred within New Zealand, to the control of any other person, that the equipment has been designed, design verified, manufactured, inspected and tested, and that documentation is supplied, in full compliance with the provisions of the Regulations. It is emphasised that these requirements also apply to previously used equipment (second-hand) whether supplied from overseas or within New Zealand. In the case of existing equipment, in New Zealand only, the documentation required shall comply with the provision that applied at the date of the manufacture of the equipment.

PART 2: Attended Boilers

2.1 Boilers with output greater than 20 MW

- 2.1.1 In addition to the provisions of part 1 of this code, attended boilers with output greater than 20MW shall comply with this section of Part 2. More than one operator may be required and special testing provisions may be necessary.
- 2.1.2 For large boilers and special-purpose boilers, the control panel may be remote from the boiler. A qualified operator shall be in attendance at the control panel and may control more than one boiler or other plant at the same time, provided such operating can be safely done. The controller shall determine the boiler(s) and other plant which a qualified operator can safely control. The controller shall also determine any further staffing requirements to assist that qualified operator.
- 2.1.3 Safe manning levels shall be verified by the equipment inspector or be documented within the owner's AS/NZS ISO 9001:2000 certified quality management system. Special cases may be referred to the Authority.
- 2.1.4 Where the boiler is part of an integrated process, the requirements of that process can be used to determine the design philosophy of the boiler auxiliaries, ancillary equipment and use of specialised fittings. The design philosophy shall include the design codes and guidelines to which the process equipment and its controls shall be built. This design philosophy shall be approved by an inspection body and shall be acceptable to the Authority.
- 2.1.5 Operating, testing, inspection, repairs, maintenance and minor modifications shall be either:
- (a) As specified in the certified AS/NZS ISO 9001:2000 quality management system for the plant; or
 - (b) As in a plan approved by an inspection body.

Major modifications shall be subject to design verification.

For attended boilers with output greater than 20 MW the remainder of this part of the code does not necessarily apply.

2.2 Attended boilers with outputs not exceeding 20 MW

- 2.2.1 Attended boilers with outputs not exceeding 20 MW shall comply with the following sections of Part 2.
- 2.2.2 Existing attended boilers that have a level of control equipment less than that required in clauses 2.3 and 2.4 may continue to be operated by a qualified operator in the immediate vicinity of the boiler at all times.

2.3 Controls and mountings

In addition to the safety valves, water level gauges, pressure gauges, blowdown valve(s), and combustion chamber thermal alarm required in Part 1, attended boilers shall have at least the following controls and mountings, which shall

comply with BS 759, or, for boilers designed to other approved codes (see Appendix A of this code), according to the rules of those codes:

- (a) Two low-water lock-outs and alarms (with the second low-water alarm mounted internally to the boiler);

NOTE: The first low-level alarm sounder may be combined with other alarms, but the second low-level alarm sounder must be independent and unique to the second low-level alarm.

- (b) Automatic feedwater control;
- (c) One safety valve on outlet side of superheater.

2.4 Low-water lock-outs and alarms

- 2.4.1 Two independent low-water lock-outs and alarms shall be fitted to the drum or shell. On a low-water level condition, the heat source shall be cut off and an audible and visible alarm initiated. This does not apply to once-through coil boilers where a steam drum is not fitted.
- 2.4.2 Both the first and second low-water lock-outs and alarms shall be set to actuate while the water level is still visible in the water level gauges.
- 2.4.3 Where equipment is available (generally below 3000 kPa operating pressure), at least one of the low-water lock-outs and alarms shall be internally mounted. For high-pressure boiler plant where internal controls are not available, isolation equipment and procedures shall be in place to ensure that operation of the boiler cannot occur with the lock-out isolated.
- 2.4.4 The second low-water alarm and fuel lock-out shall be unable to be isolated and shall be housed in an internal protection tube. A test function may be provided.

2.5 Feedwater control

- 2.5.1 Automatic water level controls shall be so arranged that they positively control the boiler feed pumps or regulate the water supply to the boilers and effectively maintain the level of water in the boiler between certain predetermined limits set by the boiler manufacturer.
- 2.5.2 Water level controls and the first low-water alarm and lock-out may be combined and housed in the same external chamber or internal protection tube.

2.6 Operational supervision

An attended boiler shall be attended by a suitably qualified operator at all times that it is being operated. For attended boilers that comply in full with these requirements, the qualified operator need not supervise the boiler continuously but should always be in a position to respond immediately to any alarms, with not more than 50 m to travel to the boiler, or the boiler control position, and shall only be employed on tasks that can be ceased immediately.

The controller shall ensure that there are no aspects of the operators' duties that would impede their supervision of the boiler at critical times and that the safety of the boiler is not compromised.

- 2.6.1 *Supervision at start-up sequences* Where an attended boiler is started up, a qualified operator shall be present at start-up and remain with the boiler until it is up to pressure and they are satisfied that it is operating correctly. Complete and detailed start-up procedures developed by the controller from the boiler manufacturer's recommendations shall be provided to the operator.
- 2.6.2 *Supervision at shut-down sequences* When an attended boiler is shut down, a qualified operator shall be present and remain with the boiler until satisfied that it has been shut down correctly.

2.7 Daily tests

- 2.7.1 Routine operation tests and observations shall be carried out on at least a daily basis, by a qualified boiler operator, as laid down in and developed from the boiler manufacturer's recommendations and/or company operating procedures.
- 2.7.2 Tests and observations include the following and any other tests considered necessary by the manufacturer:

(a) *Water level control*

Observe, and test where appropriate by blowing through the gauge glass, that the water level is being maintained between the proper upper and lower levels. For modulating feedwater controls, the water level should be maintained without feed valve oscillations (hunting).

(b) *Low-level alarms and lock-out*

A functional test shall be carried out for each alarm and lock-out to ensure that, on a low-level condition, the heat source is cut off and audible and visible alarms are initiated. Internal alarms and lock-outs shall be tested, either by a self-checking function on float switches, or for probe-type controls or float switches without self-checking functions, by lowering the water level.

NOTE: In situations where tripping the boiler on a daily basis is impractical, e.g. in a continuous operating plant, then alternative tests may be carried out on a daily basis, to prove the effectiveness of the low-level trip, with the functional tests being carried out at appropriate regular intervals.

PART 3: Limited-Attendance Boilers

Limited-attendance boilers shall be operated and maintained within a certified AS/NZS ISO 9001:2000 quality management system (see 1.31). For the definition of limited-attendance boiler see 1.4, Definitions.

3.1 Controls and mountings

- 3.1.1 Boiler controls shall comply with 1.22, Control components.
- 3.1.2 Boiler controls and mountings are classified into safety controls and operational controls. The boiler safety controls are mandatory on all limited attendance boiler installations. The boiler operational controls depend on use of the boiler and its operational and process requirements. However, both of these classes of boiler controls, where provided by the boiler design, shall be independently design verified, as provided for in appendix D of this code.
- 3.1.3 In addition to the safety valves, water level gauges, pressure gauges and blowdown valve(s) required in Part 1, limited-attendance boilers shall have at least the following control mountings, which shall comply with BS 759:
- 3.1.3.1 *Boiler safety controls:*
- (a) First low-water lock-out and alarm;
 - (b) Second, independent low-water lock-out and alarm, internally mounted, self-checking, of special design (to be hardwired);
 - (c) Feedwater availability lock-out and alarm;
 - (d) Feedwater low-pressure or low-flow lock-out and alarm;
 - (e) Combustion chamber thermal cut-out and alarm (for shell boilers); and
 - (f) Flame detector(s) to supervise both pilot and main flames for every burner, where necessary, in multi-burner furnaces (to be hardwired).
- 3.1.3.2 *Boiler operational controls:*
- (a) Feedwater control, modulated on boilers over 3 MW;
 - (b) Superheater and reheater pressure/temperature controls and alarms (for boilers with superheaters and reheaters); and
 - (c) A high-level cut-out and alarm to prevent overfilling of the boiler.
 - (d) Where there is a risk of condensate contamination by oil or grease:
 - Condensate oil and turbidity detector and alarm, and condensate diversion system.
 - (e) Where there is the risk of hardness penetration into condensate returns, or feedwater streams (e.g. by water softening plant unsupervised for depletion):
 - Feedwater monitoring alarm (e.g. conductivity) and diversion.

3.2 First low-water lock-out and alarm

- 3.2.1 On a predetermined low-water level condition, the heat source shall be cut off and an audible and visible alarm initiated. The lock-out shall require manual resetting.
- 3.2.2 The first low-level alarm may be combined with other alarm sounders.
- 3.2.3 Where alarms or lock-outs are housed in external chambers, they shall be fitted with sequencing blowdown valves, and either:
 - (a) Not be fitted with isolating valves; or
 - (b) Have isolating valves interlocked with the boiler controls to shut the boiler down if the valves are closed.

3.3 Second low-water lock-out and alarm

- 3.3.1 Limited-attendance boilers shall be fitted with an independent second water level lock-out and alarm (see clause 1.14). Independent means there shall be complete mechanical and electrical separation between this and the first low water lock-out. This device shall be of special design and comply with clause 1.22. Special design means that tests of the electrical and mechanical parts of the devices are automatically and regularly performed. The lock-out shall require manual resetting.
- 3.3.2 The second automatic self-checking device shall be internally mounted, fail-safe and not able to be isolated.
- 3.3.3 The second low-level alarm sounder must be independent and unique to the second low-level alarm.
- 3.3.4 The independent second low-water lock-out shall cut off the fuel supply to the boiler, or air to solid fuel fired boilers, and cause an audible alarm to sound when the water level in the boiler falls to a predetermined low-low water level below that in 3.2. The control or its electrical circuit shall be so arranged that it has to be reset manually before the boiler can be brought back into operation.

NOTE: In certain circumstances, it may also be desirable to cut off the fuel supply to solid-fuel-firing equipment. The general requirement is to dissipate the heat from the fuel bed quickly and the means by which this is achieved will vary according to the firing and combustion equipment, e.g. chain grate stoker, fluid bed, etc. The manufacturer's advice shall be followed. The control should cut off the FD air supply to the boiler, not the ID air flow.

3.3.5 *Float-type device*

- 3.3.5.1 Float-type low-level devices shall incorporate a functional test facility. This may be of the electromagnetic coil type, or of the cup type. They shall self-check automatically at intervals not exceeding the time taken for the boiler water level to fall from normal to 100 mm below normal, when the boiler is steaming at maximum output and no feedwater is being supplied.
- 3.3.5.2 The heat source cut-out interruption during this test shall not exceed 30 seconds. The heat source shall be locked out if:
 - (a) The water level control fails the test; or

- (b) The test sequence fails; or
- (c) The test interval is exceeded; or
- (d) The cut-out interruption period specified is exceeded.

The result of each functional test shall be clearly recognisable to the qualified operator, e.g. by light signals.

3.3.6 Probe-type device

- 3.3.6.1 Probe-type devices shall be of high-integrity design, incorporating double circuits and automatic insulation-resistance testing. Insulation-resistance testing shall be carried out at intervals not exceeding 150 seconds.
- 3.3.6.2 The heat source shall be locked out if:
 - (a) One or both of the circuits indicate a low level; or
 - (b) The insulation test fails.

3.4 Feedwater control

- 3.4.1 Automatic water level controls shall be so arranged that they positively control the boiler feed pumps or regulate the water supply to the boiler and effectively maintain the level of water in the boiler between certain predetermined limits set by the boiler manufacturer.
- 3.4.2 Water level controls and the first low-water alarm and lock-out may be combined and housed in the same external chamber or internal protection tube.
- 3.4.3 Modulating water level controls are required for boilers of 3 MW output and above.

3.5 Feedwater availability lock-out and alarm

The control system shall incorporate equipment to lock out the heat source and raise a visible and audible alarm in the event of feedwater not being available. This would normally be in the form of a low-level device in the feed tank or deaerator, or both, where feedwater can be supplied to the boiler from either.

3.6 Feedwater low-pressure or low-flow lock-out and alarm

The feedwater pump outlet shall incorporate a low-pressure or low-flow lock-out and alarm to lock out the heat source in the event of a feedpump fault. For boilers that do not incorporate modulating feedwater control, the lock-out may be interlocked with the feed pump. The pressure/flow switch must incorporate fail-safe circuitry, i.e. for mechanically-switched devices, when the pump is not running, the pressure/flow switch action must be proved.

3.7 Forced circulation

Where forced circulation is required to maintain a thermal balance in the boiler, two additional reliable safety devices shall be provided to automatically cut off the heat supply if the flow rate is reduced to a value below the allowable limit.

3.8 Combustion controls

3.8.1 Automatic firing controls, in addition to maintaining combustion products within specified limits, shall be so arranged that they effectively control the supply of fuel to the boilers, or air to solid-fuel-fired boilers, and effectively shut off the supply in the event of any one or more of the following circumstances:

- (a) Flame/pilot flame failure on oil or gas-fired boilers;
- (b) Failure to ignite the fuel on oil or gas-fired boilers within a predetermined time;
- (c) When a predetermined high pressure at or below the safety valve set pressure is reached;
- (d) When the water level falls to a predetermined point below the normal operating level (the first low-water level);
- (e) Failure of forced or induced draught fans, or any automatic flue damper, when these are provided;
- (f) When the combustion chamber thermal cut-out is activated (shell boilers only);
or
- (g) When the water level falls to a predetermined point below that in (d) above (the second low-water level).

NOTE: In the case of (a), (b), (d), (e) and (g), these controls shall be of the lock-out type requiring manual resetting.

3.8.2 In the event of a flame, pilot flame or ignition failure, the control system shall proceed to the lock-out condition.

3.9 Combustion chamber thermal cut-out and alarm

For shell boilers, a thermal cut-out and alarm shall be provided for the back end combustion chamber and shall be set to operate at a temperature below the value specified in clause 1.11.5. The maintenance contractor shall establish that the cut-out operates below this specified temperature. The position(s) of the thermal sensor(s) shall be specified by the boiler manufacturer and shall not be altered.

3.10 Power failure safeguards for solid fuel boiler installations

3.10.1 In the event of a power failure, cut-out or lock-out initiated by the feedwater system or the boiler control system, provision shall be made to ensure that the water contained in the boiler is not evaporated to the extent that it disappears from the gauge glass. Excessive heat shall be dissipated from the boiler to eliminate this danger.

3. 10.2 For boilers containing sufficient water reserves, on cut-out of the firing system from steady maximum-design, full-load operation with the water level at the "pump-on" level (lowest controlled water level), the flue gas temperature at the highest point of the heating surface shall be reduced to below 400°C before the water level has sunk to 50 mm above the highest point of the heating surface. The water level at this position shall be visible in the gauge glass.
- 3.10.3 For boilers not containing sufficient wafer reserves, two independently driven and controlled standby feed pumps shall be provided. At least one of these must be capable of starting automatically and functioning independently in the event of a complete power failure. This requirement may be fulfilled in boilerhouses provided with an automatic standby generator if this generator is of sufficient capacity to meet the requirements of the feedwater pumps plus any other connected load. The following conditions shall be fulfilled:
- (a) Both standby feed pumps shall be provided with independent control devices.
 - (b) Sufficient water reserves shall always be available for safe start up operation, with the water level being monitored by a water level limiter of special design.
 - (c) In the event of failure of an operating pump, the standby pump shall start automatically, and a feed pump failure alarm shall be raised.
 - (d) A feed pump alarm shall remain displayed until the associated fault has been rectified.
3. 10.4 At commissioning functional tests shall be made to prove:
- (a) The boiler's ability to comply with 3.10.2 at full steam extraction with no feed water; or
 - (b) The boiler's ability to comply with 3.10.3 at full steam extraction and with the water at the lowest attainable level in the feedwater tank.

3.11 Alarms

In addition to the requirements in 1.23 (Fault alarms and lock-outs) the following conditions apply:

- 3.11.1 For all limited-attendance boilers, an emergency device, which will shut off the heat source, shall be at a remote location from the boiler house and shall be clearly marked.
- 3.11.2 The alarm system shall be designed with self-monitoring properties. See also 1.25.2.
- 3.11.3 For shell boilers, an alarm shall be provided (see 3.9) to warn when the gas temperature at the tube entry to the first pass from the combustion chamber approaches the maximum temperature designated by the manufacturer (see also 1.11.5).
- 3.11.4 Depending on circumstances, a suitable connection may be allowed to a dialling system and pagers.

3.12 Visual display

A visual display shall be provided to indicate the status of all the critical operating and safety devices at all stages of operation and to identify the alarm condition. This display shall indicate power-on, the initiation of the start-up sequence and which of alternate components, e.g. pumps, are operating. Other conditions to be displayed are as in AS 2593.

3.13 Operational supervision

- 3.13.1 A limited-attendance boiler shall have a suitably qualified operator available on site and in the near vicinity at all times that it is being operated.
- 3.13.2 Limited-attendance boilers not operated under a certified AS/NZS ISO 9001:2000 quality management system may be operated under a management system audited by an inspection body for a maximum of one year, after which time they shall have achieved certification, for operation and maintenance.
- 3.13.3 Where there is a situation where the AS/NZS ISO 9001:2000 quality management system is not yet fully in place, or it has lapsed, then the limited-attendance boiler which should have been covered by this system shall be operated on a one-hourly check basis.

3.13.4 Supervision at start-up sequences

- 3.13.4.1 Where a limited-attendance boiler is started up manually or automatically, a qualified operator shall be present at start-up and remain with the boiler until it is up to pressure and the operator is satisfied that it is operating correctly.
- 3.13.4.2 Complete and detailed start-up procedures as recommended by the boiler manufacturer shall be provided to the operator and be available in the boilerhouse.

Note: The controls shall be subjected to the daily operating test shortly after start-up but when operating conditions have stabilised and before the qualified operator leaves the immediate vicinity of the boiler.

3.13.5 Supervision at shut-down sequences

- 3.13.5.1 Where a limited-attendance boiler is shut down manually or automatically, a qualified operator shall be present and remain with the boiler until satisfied that it is shut down correctly.
- 3.13.5.2 In the event of failure of the automatic controls, and where the boiler is capable of being brought under manual control safely, operation under manual control shall be in accordance with a clearly defined operating procedure that shall include the immediate presence of an appropriately qualified operator. Continuous manual supervision shall be provided until the fault in the controls has been rectified and a suitable period of time has elapsed to ensure by testing that the boiler and its controls are operating normally.
- 3.13.5.3 Whenever a limited-attendance boiler is transferred to "attended operation", the reasons and time shall be recorded by the data logger or by an entry in the boiler room log book, which shall be signed by the qualified operator.

3.14 Testing of lock-outs, cut-outs and alarms

3.14.1 Routine operation tests and observations shall be carried out periodically by a qualified operator as laid down in and developed from the boiler manufacturer's instructions or the company operating procedures. The boiler shall remain attended at all times during tests.

3.14.2 Water level control

3.14.2.1 Observe and test where appropriate, by blowing through the gauge glass, that the water level is being maintained between the proper upper and lower levels.

3.14.2.2 For modulating feedwater controls, the water level should be maintained without feed valve oscillations (hunting).

3.14.3 Low-level lock-outs and alarms

3.14.3.1 At least weekly, a functional test shall be carried out for every water level alarm and lock-out to ensure that on a low-level condition the heat source is cut off, and audible and visible alarms are initiated.

3.14.3.2 In installations where the first low-water alarm and lock-out is self-monitoring, of special design, this test period in 3.14.3.1 may be extended to one month.

3.14.3.3 A functional test shall consist of lowering the water level in the boiler and verifying that the heat source is cut off, and the audible and visual alarms are initiated.

3.14.3.4 It may be necessary to disable the first lock-out and alarm to verify the full function of the second lock-out and alarm. The first alarm shall only be disabled by active means, i.e. the operator shall hold a push-button depressed. There shall be no possibility of permanent disablement.

3.14.3.5 At no time during a test of the water level controls shall the water be lowered to the extent that it disappears from the gauge glass.

3.14.3.6 The automatic start and operation of the independently driven standby feed pump, on failure of the duty feed pump, shall be included in the functional testing programme of clause 3.14.3.1.

3.15 Periodic tests

The approved maintenance contractor shall carry out a functional test of all alarm and lock-out safety systems at regular intervals (recommend quarterly). The results of these tests shall be recorded. Where set points are disturbed in order to carry out such tests, then the maintenance contractor shall record and verify on the report that the set point has been reset correctly. At least once per year, safety controls which require setpoint adjustment to test shall be fully tested for the complete physical operation of the device.

3.16 Water treatment

3.16.1 In addition to normal in-house boiler water testing for limited-attendance boilers, the boiler water shall be analysed at 3-monthly intervals by a laboratory accredited by IANZ (International Accreditation New Zealand) or NATA (National Association of Testing Authorities) for the testing of boiler waters.

3.16.2 The boiler water samples shall be taken via an approved cooling device.

3.17 Boiler control and safety systems

3.17.1 Maintenance

3.17.1.1 Maintenance of the boiler control and safety systems shall be carried out by a maintenance contractor who is nominated by the controller, acceptable to the boiler manufacturer and who is certified to AS/NZS ISO 9001:2000 for the maintenance of boiler control systems.

3.17.1.2 Controllers who are certified to AS/NZS ISO 9001:2000 for the maintenance of boiler control systems may nominate themselves to conduct their own maintenance of the boiler control and safety system provided:

- (a) The boiler manufacturer is satisfied that the persons doing the maintenance are suitably qualified and have had adequate training; and
- (b) All the necessary information, drawings and details are held on site and all processes and procedures are detailed within the quality management system.

3.17.2 Relocation

When a boiler is relocated its boiler control system is to be revalidated against the verified design.

PART 4: Under 15 HP Boilers

4.1 General

- 4.1.1 Under 15 hp boilers are not required to be operated by a qualified boiler operator. However, they are not classified as unattended boilers.
- 4.1.2 This class of boiler has a power output under 1.2 M W and/or a steam output from and at 100° C not exceeding 1814 kg of steam per hour.
- 4.1.3 All new boilers in this category shall comply in full with the requirements relating to 4.2 and 4.3, below or limited-attendance boilers or unattended boilers as specified in this code.
- 4.1.4 Under 15 hp boilers may be upgraded to unattended boilers provided they meet the requirements of this code.
- 4.1.5 Boilers that are not upgraded need to be fitted with the minimum controls and mountings specified in 4.2 and are required to be checked every two hours by a responsible person.
- 4.1.6 New boilers may be built for unattended or limited attendance operation, or if fitted with controls and mountings required in 4.2 will be required to be checked every 2 hours.
- 4.1.7 Boilers that comply with 4.2 will need to be operated by a qualified operator where two or more are coupled together.

4.2 Controls and mountings

In addition to the safety valves, water level gauges, pressure gauges, blowdown valve(s) and combustion chamber thermal alarm required by Part 1 of this code, under 15 hp boilers shall have at least the following control mountings, which shall comply with BS 759:

- (a) Two independent low-water alarms and lock-outs; and
- (b) On-off feedwater control.

4.3 Operational supervision

- 4.3.1 An under 15 hp boiler shall have a responsible person available at all times that it is being operated. That person should be within hearing distance of the boiler alarms and employed on a task that can be ceased immediately.
- 4.3.2 Direct observations of the boiler running conditions shall be made by the responsible person at intervals not exceeding 2 hours.

4.4 Under 15 hp boilers built to Standards other than BS 2790:1982, or to earlier editions of that Standard

Numerically, the majority of boilers in New Zealand fit in this category. Existing under 15 hp boilers may continue to be operated under their present location and supervision conditions, as long as they remain in good enough condition to be issued with a certificate of inspection.

These boilers may not be suitable for upgrading to limited-attendance or unattended operation (see clause 1.8).

4.5 Under 15 hp boilers built to BS 2790:1982, or to later editions of that Standard

Existing boilers in this category may be suitable for upgrading to limited-attendance or unattended operation, provided that they have been maintained in good condition.

4.6 Coupled boilers

When two or more boilers which are not classed as limited-attendance or unattended boilers are connected to a common steam main and their aggregate horsepower exceeds 15, or their combined output exceeds 1814 kg of steam per hour from and at 100°C, they shall comply with all attendance requirements applying to "attended boilers" and shall be attended by a qualified operator or responsible person, according to Table 1.3 of this code.

4.7 Existing boilers

- 4.7.1 Boilers which are damaged, or which have their pressure parts structurally modified, shall have the water level controls, alarms and fuel lock-outs upgraded to the "unattended" specifications. For upgrading of existing shell boilers, see also 1.8 (Upgrading existing shell boilers).
- 4.7.2 Boilers which have been modified under these circumstances shall continue to be checked every 2 hours and are not to be regarded as unattended boilers.

PART 5: Unattended Boilers

5.1 Operation

- 5.1.1 Unattended boilers shall be operated and maintained within a certified AS/NZS ISO 9001:2000 quality management system where specified in 1.31. For the definition of unattended boiler see 1.4, Definitions.
- 5.1.2 Unattended boilers may only be run in unattended mode; they may not be run attended even for brief periods. Failure of the boiler control system shall result in the boiler being shut down until the boiler control system has been repaired.
- 5.1.3 5.1.2 above does not apply to the operator surveillance of the firing system and ash handling system, deemed necessary for solid fuel boilers by the manufacturer or the boiler controller.

5.2 Controls and mountings

- 5.2.1 Boiler controls shall comply with 1.22, Control components.
- 5.2.2 Boiler controls and mountings are classified into safety controls and operational controls. The boiler safety controls are mandatory on all unattended boiler installations. The boiler operational controls depend on use of the boiler and its operational and process requirements. However, both of these classes of boiler controls, where provided by the boiler design, shall be independently design verified, as provided for in Appendix D.
- 5.2.3 In addition to the safety valves, water level gauges, pressure gauges and blowdown valve(s) required in Part 1 of this code, unattended boilers shall have at least the following control mountings, which shall comply with BS 759:
 - 5.2.3.1 *Boiler safety controls:*
 - (a) First low-water lock-out and alarm;
 - (b) Second, independent low-water lock-out and alarm, internally mounted, self-checking, of special design (to be hardwired);
 - (c) Feedwater availability lock-out and alarm;
 - (d) Feedwater low-pressure or low-flow lock-out and alarm;
 - (e) Combustion chamber thermal cut-out and alarm (for shell boilers);
 - (f) Flame detector(s) to supervise both pilot and main flames for every burner, where necessary, in multi-burner furnaces (to be hardwired);
 - (g) Automatic continuous blowdown control (TDS control); and
 - (h) A steam limiting valve in installations where there is a heavily fluctuating steam demand.
 - 5.2.3.2 *Boiler operational controls:*
 - (a) Superheater and reheater pressure/temperature controls and alarms (for boilers with superheaters and reheaters); and
 - (b) A high-level cut-out and alarm to prevent overfilling of the boiler.

(c) Where there is a risk of condensate contamination by oil or grease:

Condensate oil and turbidity detector and alarm, and condensate diversion system.

(d) Where there is the risk of hardness penetration into condensate returns, or feedwater streams (e.g. by water softening plant unsupervised for depletion):

Feedwater monitoring alarm (e.g. conductivity) and diversion.

5.3 First low-water lock-out and alarm

5.3.1 On a predetermined low-water level condition, the heat source shall be cut off and an audible and visible alarm initiated. The lock-out shall require manual resetting.

5.3.2 The first low-level alarm sounder may be combined with other alarm sounders.

5.3.3 Where alarms or lock-outs are housed in external chambers, they shall be fitted with sequencing blowdown valves, and either:

(a) Not be fitted with isolating valves; or

(b) Have isolating valves interlocked with the boiler controls to shut the boiler down if the valves are closed.

5.3.4 The low-water lock-out device shall comply with 1.22, Control components.

5.4 Second low-water lock-out and alarm

5.4.1 Unattended boilers shall be fitted with an independent second water level lock-out and alarm (see clause 1.14, Water level gauges). "Independent" means there shall be complete mechanical and electrical separation between this and the first lock-out. This device shall be of special design and comply with clause 1.22, Control components. Special design means that tests of the electrical and mechanical parts of the devices are automatically and regularly performed. The lock-out shall require manual resetting.

5.4.2 The second automatic self-checking device shall be internally mounted, fail-safe and not able to be isolated.

5.4.3 The second low-level alarm sounder must be independent and unique to the second low-level alarm.

5.4.4 The independent second control shall cut off the fuel supply to the boiler, or air to solid fuel fired boilers, and cause an audible alarm to sound when the water level in the boiler falls to a predetermined low-low water level below that in 5.9.1 (d) below. The control or its electrical circuit shall be so arranged that it has to be reset manually before the boiler can be brought back into operation.

NOTE: In certain circumstances, it may also be desirable to cut off the fuel supply to solid fuel firing equipment. The general requirement is to dissipate the heat from the fuel bed quickly and the means by which this is achieved will vary according to the firing and combustion equipment, e.g. chain grate stoker, fluid bed, etc. Manufacturer's advice shall be followed. The control should cut off the FD air supply to the boiler, not the ID air flow.

5.4.5 *Float-type device*

- 5.4.5.1 Float-type low-level devices shall incorporate a functional test facility. This may be of the electromagnetic coil type, or of the cup type. They shall self-check automatically at intervals not exceeding the time taken for the boiler water level to fall from normal to 100 mm below normal, when the boiler is steaming at maximum output and no feedwater is being supplied.
- 5.4.5.2 The heat source cut-out interruption during this test shall not exceed 30 seconds. The heat source shall be locked out if:
- (a) The water level control fails the test;
 - (b) The test sequence fails;
 - (c) The test interval is exceeded; or
 - (d) The cut-out interruption period specified is exceeded.
- 5.4.5.3 The result of each functional test shall be clearly recognisable to the qualified operator, e.g. by light signals.

5.4.6 *Probe-type device*

Probe-type devices shall be of high-integrity design incorporating double circuits and automatic insulation-resistance testing. Insulation-resistance testing shall be carried out at intervals not exceeding 150 seconds.

The heat source shall be locked out if:

- (a) One or both of the circuits indicate a low level; or
- (b) The insulation test fails.

5.5 Feedwater control

- 5.5.1 Automatic water level controls shall be so arranged that they positively control the boiler feed pump(s) or regulate the water supply to the boilers and effectively maintain the level of water in the boiler between certain predetermined limits set by the boiler manufacturer.
- 5.5.2 *Changeover*
- 5.5.2.1 The feedwater pump system shall be controlled so that every time a pump is stopped automatically, the operating pump shuts down and the alternate pump is started. Where the pump operation is continuous, an automatic or manual changeover shall be made once at least in every 24 hours. In the event of the failure of the operating pump, the other pump shall take over automatically and the failure of the first pump shall be clearly indicated.
- 5.5.2.2 For solid fuel boiler installations, two independently driven feed pumps shall be provided. These shall comply with the relevant provisions of 5.11. A test function to prove the system shall be provided.

5.6 Feedwater availability lock-out and alarm

The control system shall incorporate equipment to lock out the heat source and raise a visible and audible alarm in the event of feedwater not being available. This would normally be in the form of a low-level device in the feed tank or deaerator, or both, where feedwater can be supplied to the boiler from either.

5.7 Feedwater low-pressure or low-flow lock-out and alarm

The feedwater pump outlet shall incorporate a low-pressure or low-flow lock-out and alarm to lock out the heat source in the event of a feedpump fault. For boilers that do not incorporate modulating feedwater control, the lock-out may be interlocked with the feedpump. The pressure/flow switch must incorporate fail-safe circuitry, i.e. for mechanically-switched devices when the pump is not running, the pressure/flow switch action must be proved.

5.8 Forced circulation

Where forced circulation is required to maintain a thermal balance in the boiler, two additional reliable safety devices shall be provided to automatically cut off the heat supply if the flow rate is reduced to a value below the allowable limit.

5.9 Combustion controls

5.9.1 Automatic firing controls, in addition to maintaining combustion products within specified limits, shall be so arranged that they effectively control the supply of fuel to the boilers, or air to solid fuel fired boilers and effectively shut off the supply in the event of any one or more of the following circumstances:

- (a) Flame/pilot flame failure on oil- or gas-fired boilers;
- (b) Failure to ignite the fuel on oil- or gas-fired boilers within a predetermined time;
- (c) When a predetermined high pressure at or below the safety valve set pressure is reached;
- (d) When the water level falls to a predetermined point below the normal operating level (the first low-water level);
- (e) Failure of forced or induced draught fans, or any automatic flue damper, when these are provided;
- (f) When the combustion chamber thermal cut-out is activated (shell boilers only);
or
- (g) When the water level falls to a predetermined level below that in (d) above (the second low-water level).

NOTE: In the case of (a), (b), (d), (e) and (g), these controls shall be of the lock-out type requiring manual resetting.

5.9.2 In the event of a flame, pilot flame or ignition failure, the control system shall proceed to the lock-out condition.

5.10 Combustion chamber thermal cut-out and alarm

For shell boilers, a thermal cut-out and alarm shall be provided for the back end combustion chamber and shall be set to operate at a temperature below the value specified in 1.11.5. The maintenance contractor shall establish that the cut-out operates below this specified temperature. The position(s) of the thermal sensor(s) shall be specified by the boiler manufacturer and shall not be altered.

5.11 Power failure safeguards for solid fuel boiler installations

- 5.11.1 In the event of a power failure, cut-out or lock-out initiated by the feedwater system or the boiler control system, provision shall be made to ensure that the water contained in the boiler is not evaporated to the extent that it disappears from the gauge glass. Excessive heat shall be dissipated from the boiler to eliminate this danger.
- 5.11.2 For boilers containing sufficient water reserves, on cut-out of the firing system from steady full-load operation with the water level at the "pump on" level (lowest controlled water level), the flue gas temperature at the highest point of the heating surface shall be reduced to below 400°C before the water level has sunk to 50 mm above the highest point of the heating surface. The water level at this position shall be visible in the gauge glass.
- 5.11.3 For boilers not containing sufficient water reserves, two independently driven and controlled feed pumps shall be provided. At least one of these must be capable of starting automatically and functioning independently in the event of a complete power failure. This requirement may be fulfilled in boiler houses with a standby generator if this generator is of sufficient capacity to meet the requirements of the feedwater pumps plus any other connected load.

The following conditions shall be fulfilled:

- (a) Both feed pumps shall be provided with independent control devices.
 - (b) Sufficient water reserves shall always be available for safe start-up operation, with the water level being monitored by a water level limiter of special design.
 - (c) In the event of the failure of the operating pump, the standby pump shall start automatically.
 - (d) Failure of the operating feed pump shall remain indicated.
 - (e) The feedwater pump system shall be controlled so that every time a pump is stopped automatically, the operating pump shuts down and the alternate pump is started. Where the pump operation is continuous, an automatic changeover shall be made every 24 hours.
- 5.11.4 At commissioning, functional tests shall be made to prove:
- (a) The boiler's ability to comply with 5.11.2 at full steam extraction and cut off feeding; or
 - (b) The boiler's ability to comply with 5.11.3 at full steam extraction and with the water at the lowest attainable level in the feedwater tank.

5.12 Alarms

In addition to the requirements in 1.23 (Fault alarms and lock-outs), the following conditions apply:

- 5.12.1 All unattended boilers shall have an emergency device which will shut off the heat source. This shall be at a remote location from the boiler house and be clearly marked.
- 5.12.2 The alarm system shall be designed with self-monitoring properties. See also 1.25.2.
- 5.12.3 For shell boilers, an alarm shall be provided (see 5.10) to warn when the gas temperature at the tube entry to the first pass from the combustion chamber approaches the maximum temperature designated by the manufacturer (see also 1.11.5).
- 5.12.4 Depending on the circumstances, a suitable connection may be allowed to dialling system and pagers.

5.13 Visual display

A visual display shall be provided to indicate the status of all the critical operating and safety devices at all stages of operation and to identify the alarm condition. This display shall indicate power-on, the initiation of the start-up sequence, and which of the alternate components, e.g. pumps, are operating. For other conditions to be displayed, reference should be made to AS 2593.

5.14 Operational supervision

- 5.14.1 An unattended boiler shall have a responsible person designated at all times that it is being operated. This person shall be capable of verifying that all the control and alarm systems are functioning correctly. In addition to this responsible person, the services of an approved maintenance contractor should be available.
- 5.14.2 Where control systems are fitted which have automatic testing facilities and are self-monitoring, then the controls shall still be checked by the responsible person on a weekly basis and after a cold start, including during periods such as the night and weekends. While the boiler is in operation, and during such periods, there should always be somebody available who is competent to respond to alarms, and to take appropriate action which, at a minimum, may be to ensure that the boiler shuts down safely before calling for assistance.
- 5.14.3 Alarms may be transmitted to the responsible person via a phone dialler (paging system) provided the boiler manufacturer/maintenance contractor responsible for conversion of the boiler and the inspection body are satisfied that:
 - (a) The controls/monitoring/communications facilities provided are adequate; and
 - (b) Safety would not be compromised.

These alarms may not be reset from a remote location. A responsible person shall attend the boiler to reset these alarms.

5.14.4 An unattended boiler may be started by a time switch or other remote device without the responsible person being present in the boiler house provided the boiler manufacturer/maintenance contractor responsible for conversion of the boiler and the inspection body are satisfied that:

- (a) The controls/monitoring/communications facilities provided are adequate; and
- (b) Safety would not be compromised.

5.14.5 Automated start-up

The control system shall check that all boiler conditions are within predetermined limit ranges. If conditions are outside these limits, then the system shall shut down.

These controls and conditions include:

- (a) Electric power supply is available;
- (b) Operation of fuel valves;
- (c) Boiler water at correct level;
- (d) Feedwater supply;
- (e) Circulation pump;
- (f) Purge/combustion air;
- (g) Fuel supply in correct condition of temperature, viscosity, etc;
- (h) Burner low/high fire control;
- (i) Atomising medium available at correct pressure if required;
- (j) Ignition;
- (k) Flame sensor; and
- (l) Water at correct level in the feedwater tank.

For solid fuel fired boilers they also include:

- (m) Fuel supply system in start position.

5.14.6 Data loggers

Data loggers should be incorporated in the control system to regularly log the boiler operating conditions and alarms.

5.14.7 Automated main steam stop

Where an automated main steam stop is fitted, provision shall be made to warm through all the steam lines and drains downstream.

5.14.8 Management of shutdown sequence

Automated boiler shutdown procedures shall be in accordance with the boiler manufacturer's recommendations.

5.15 Testing of lock-outs, cut-outs and alarms

Routine operation tests and observations shall be carried out periodically by a responsible person, as laid down in and developed from the boiler manufacturer's recommendations and company operating procedures. The boiler shall remain attended at all times during the tests.

5.15.1 *Water level control*

5.15.1.1 Observe and test, where appropriate, by blowing through the gauge glass, that the water level is being maintained between the proper upper and lower levels.

5.15.1.2 For modulating feedwater controls, the water level should be maintained without feed oscillations (hunting).

5.15.2 *Low-level lock-outs and alarms*

5.15.2.1 At least weekly, a functional test shall be carried out for every water level alarm and lock-out to ensure that on a low-level condition the heat source is cut off, and audible and visible alarms are initiated.

5.15.2.2 In installations where the first low-water alarm and lock-out is self-monitoring, internally mounted, of special design, this test period in 5.15.2.1 may be extended to one month.

5.15.2.3 A functional test shall consist of lowering the water level in the boiler and verifying that the heat source is cut off, and the audible and visual alarms are initiated.

5.15.2.4 It may be necessary to disable the first lock-out and alarm to verify the full function of the second lock-out and alarm. The first alarm shall only be disabled by active means, i.e. the operator shall hold a push button depressed. There shall be no possibility of permanent disablement.

Note: In situations where tripping the boiler on a daily basis is impractical, e.g. in a continuous operating plant, then alternative tests may be carried out on a daily basis, to prove the effectiveness of the low-level trip, with the functional tests being carried out at appropriate regular intervals.

5.15.3 *Standby feed pump*

The automatic start and operation of the independently driven standby feed pump, on failure of the duty feed pump, shall be tested.

5.16 Quarterly tests

The approved maintenance contractor shall carry out a functional test of all alarm and lock-out safety systems quarterly. The results of these tests shall be recorded. Where set points are disturbed in order to carry out such tests, then the maintenance contractor shall record and verify on the report that the set point has been reset correctly. At least once per year, safety controls which require setpoint adjustment to test shall be fully tested for the complete physical operation of the device.

5.17 Water treatment

- 5.17.1 In addition to normal in-house boiler water testing for unattended boilers, the boiler water shall be analysed at monthly intervals by a laboratory accredited by IANZ (International Accreditation New Zealand) or NATA (National Association of Testing Authorities) for the testing of boiler waters.
- 5.17.2 The boiler water samples shall be taken via an approved cooling device.

5.18 Boiler control system

5.18.1 Maintenance

- 5.18.1.1 Maintenance of the boiler control systems shall be carried out by a maintenance contractor who is nominated by the controller, acceptable to the boiler manufacturer and who is certified to AS/NZS ISO 9001:2000 for the maintenance of boiler control systems. The authority shall be given an opportunity to participate in these quality management system audits.

These systems and devices shall be checked at regular intervals, at least three-monthly, and additionally when problems arise. The three-monthly check shall include the control and limiting devices that are not subject to daily checking.

- 5.18.1.2 Controllers who are certified to AS/NZS ISO 9001:2000 for the maintenance of boiler control systems may nominate themselves to conduct their own maintenance of the boiler control and safety system provided:
- (a) The boiler manufacturer is satisfied that the persons doing the maintenance are suitably qualified and have had adequate training; and
 - (b) All the necessary information, drawings and details are held on site and all processes and procedures are detailed within the quality management system.

5.18.2 Relocation

When a boiler is relocated its boiler control system is to be revalidated against the verified design.

PART 6: Once-Through Forced Circulation Coil Boilers

This section refers to coil boilers, which shall comply with AS 1228, BS 1113 or the *ASME Boiler and Pressure Vessel Code*, section 1.

In addition to the requirements outlined in parts 3 to 5 of this code, as applicable, the following provisions apply.

An inspection body shall determine the equivalence of any safety feature for a particular installation, to the ones required in this code.

6.1 Standards for controls

The fuel management system for coil boilers shall be the same as for unattended boilers. The same purging, pilot ignition and self-checking flame supervision requirements apply (see 5.14 Operational supervision, above).

6.2 Forced circulation coil boilers

Forced circulation coil boilers shall have at least the following controls:

6.2.1 The feedwater and fuel supplies shall be controlled automatically and these controls shall be interconnected.

6.2.2 Overheating interlock

At least two separate devices shall be provided, operating on coil temperature, steam temperature or flue temperature, to protect against overheating due to loss of feedwater flow or scale buildup. The actuation of any overheating protection device shall cause shutdown and shall require manual reset.

6.2.3 Water circulation pump, flow/combustion interlock

Every boiler shall be fitted with a controlled circulation pump which shall be interlocked to prevent operation of the combustion equipment unless water flow is established and maintained.

NOTE: In some boilers, the circulating pump may be the feedwater pump.

6.2.4 Combustion controls

The boiler control system of a forced circulation boiler shall shut down the fuel input and cause lock-out to occur in the event of any of the following:

- (a) Inadequate air for satisfactory combustion or purging;
- (b) Incorrect pressure/temperature in the fuel supply;
- (c) Start or main flame ignition failure;
- (d) Flame failure; or
- (e) Failure of flame detector to pass self-check test.

NOTE: See also 1.10.4.

6.3 Feedwater pump

- 6.3.1 Every boiler over 500 kW shall be fitted with two automatically controlled feedwater pumps, each capable of supplying not less than 110% of the mass of steam generated at the power output of the boiler calculated on the basis of feedwater at 100°C and at design pressure.
- 6.3.2 The feedwater pump system shall be controlled such that after each automatic pump stop, the operating pump shuts down and the alternative pump is started. Where pump operation is continuous, a manual changeover shall be made at regular intervals.
- 6.3.3 Notwithstanding the above, one feedwater pump shall be acceptable provided that the feedpump is individual to the boiler and that means are provided to automatically shut down and lock out the energy input system in the event of the temperature of the fluid leaving the coil system exceeding that corresponding to the saturation temperature at design pressure.

6.4 Pressure safety

Coil boilers, including the uptake and all fittings to the boiler, shall be provided with a casing capable of withstanding the forces created due to a burst tube.

PART 7: Small Boilers

For the purpose of this code of practice, small boilers are those under 500 kW with a maximum pressure of 1000 kPa and a maximum volume of 1500 litres.

Note: Electric and electrode boilers shall be designed and built to an appropriate acceptable pressure vessel standard. Such equipment is covered by the *Approved Code of Practice for Pressure Equipment (Excluding Boilers)*.

7.1 Standards for controls

Small boilers shall have at least the following control mountings, in addition to those required in part 1 (see 1.13, 1.14 and 1.15), which shall comply with BS 2790:

- (a) Safety valves as required in BS 2790;
- (b) Two independent means of indicating the water level;
- (c) One pressure gauge;
- (d) Two low-water alarms and lock-outs;
- (e) Automatic feedwater control; and
- (f) Blowdown valve.

The lower of the probes in (d), above, shall be of the high integrity type. (See also 1.22 Control components.)

7.2 Operational supervision

- 7.2.1 A small boiler shall have a responsible person available at all times that it is being operated. That person should be within hearing distance of the boiler alarms and may only be employed on tasks that can be ceased immediately.
- 7.2.2 Direct observations of the boiler running conditions must be made at intervals not exceeding 24 hours.
- 7.2.3 For retention of operation and maintenance records, refer to 1.26.5.

PART 8: Pressurised Hot Water Boilers

In addition to the applicable provisions of part 1 of this code, the following requirements apply specifically to the design, manufacture (including controls) and operation of hot water boilers with a working temperature exceeding 100°C and pressure exceeding 200 kPa, by use of a directly applied combustion process, or by application of heated gases.

8.1 Standards

Hot water boilers exceeding the temperature and pressure limits above shall be designed, fabricated and tested in accordance with BS 2790, BS 1113, BS 855 or AS 1228, and the provisions of this code.

8.2 Types of system

8.2.1 For the purpose of ensuring compliance with the requirements of this section, fully flooded boiler systems can be divided into four basic categories:

Category A: Static head systems open to atmosphere.

Category B: Closed pressurised systems with separate gas-cushioned pressurising vessels and provision for make-up water.

Category C: Sealed pressurised systems with separate diaphragm or bladder-type pressuring vessels and provision for make-up water.

Category D: Continuously pumped pressurised systems with provision for make-up water.

8.2.2 Boilers in all these categories shall be part of a closed-circulation hot water system. Not all boilers within these categories may come within the scope of these requirements.

8.2.3 Boilers pressurised by steam are classified as steam boilers and shall comply with the requirements for steam boilers. Category A boilers are not suitable for high-temperature operation.

8.2.4 In fire tube boilers, the water inlet and outlet shall be located at the top of the boiler in such a way as to promote circulation to minimise both thermal shock and loss of water in the event of external pipe breakage.

Every hot water system shall:

- (a) Be a closed circulation system with no steam or water consumed during operation;
- (b) Be designed and constructed so that loss of water or loss of flow cannot create a hazard in the boiler or system;
- (c) Be equipped with the provision to expand to accommodate the volume fluctuations in the system, such expansion vessel maintaining a positive system pressure at all times that the boiler is in operation, using inert gas, steam or liquid head; and

(d) Have a difference between the water flow temperature (outlet) and the water return temperature (inlet) as specified in the recognised hot water boiler design standard (Appendix A). In the case that the recognised design standard used does not specify this value, it shall not exceeding the following:

- fire tube boilers 25°C
- natural circulation water tube boilers 50°C
- forced circulation water tube boilers 80°C.

An external or internal mixing device shall be fitted, where necessary, to raise the water return temperature to bring the differential to within the above limits.

8.3 Automatic controls

8.3.1 The categories of fully-flooded hot water boilers operating with minimum supervision shall be provided with automatic controls. Such controls should shut off the supply of fuel to oil or gas burners, or should shut off the air supply and, if necessary, the fuel supply to solid fuel firing equipment in the event of one or more of the following circumstances arising:

- (a) Flame failure or pilot flame failure on oil, gas or dust burners. This control should be of the lock-out type requiring manual resetting.
- (b) Failure to ignite the fuel within a predetermined time. This control should be of the lock-out type requiring manual resetting.
- (c) Failure of forced or induced draught fan, or an automatic flue damper.
- (d) When the water at or near the boiler flow outlet rises to a predetermined temperature. This temperature shall provide a margin of at least 17°C below the temperature of saturated steam corresponding with the pressure prevailing at the most vulnerable point in the heating circuit.
- (e) When the water level in the pressurising equipment in a Category B system falls to a predetermined level below the normal operating level. This control should also cause an audible alarm to operate.
- (f) When the pressure in a Category B, C, or D system falls to a predetermined pressure below the specified operating pressure. This predetermined pressure should be at a level which will ensure that the water does not reach boiling point in any part of the system whilst the working temperature is maintained.
- (g) When the pressure in a Category C system increases to within 35 kPa of safety valve set pressure. The safety valve set pressure should be such that it will not allow the design pressure of any part of the system to be exceeded.

8.3.2 For a finned tube-type hot water boiler, a sequenced lock-out device should be fitted to ensure that the burner cannot be operated at any time unless the circulating pump is running.

8.4 Independent overriding controls

8.4.1 In addition to the automatic controls required by clause 8.3, all categories of fully flooded hot water boilers should be provided with independent overriding controls which cut off the fuel supply to oil or gas burners, or cut off the air supply and, where required, the fuel supply to solid fuel firing equipment in the event of one or more of the following circumstances arising:

- (a) When the temperature of water at or near the boiler flow outlet rises to a predetermined temperature providing a margin below the temperature of saturated steam corresponding with the pressure at the highest point of the circulating system above the boiler. For oil- or gas-fired boilers, this margin should be at least 6°C and for solid fuel fired boilers be at least 10°C. This control should be the lock-out type requiring manual resetting.
- (b) When the water level in the pressurising equipment of a Category B system falls to a predetermined level further below the normal operating level than that indicated in 8.3.1 (e). This control should lock out the firing equipment and should be of a type which requires manual resetting.

NOTE: In certain circumstances, it may be desirable to cut off the fuel supply to solid fuel firing equipment. The general requirement is to dissipate the heat from the fuel bed quickly and the means by which this is achieved will vary according to the firing and combustion equipment, e.g. chain grate stoker, fluid bed, etc. Manufacturer's advice should be sought.

8.4.2 Fully-flooded hot water boilers shall have provision to prevent the boiler being fired unless it is fully flooded.

8.5 Electrical failure to safety

8.5.1 All electrical equipment and systems used for operating controls shall be designed to fail-safe in the event of mains supply or single component failure.

8.5.2 All electrical conductors and equipment in connection with water level or temperature and firing controls should be of adequate size, and be properly insulated and protected to prevent danger including, where necessary, adequate protection against the ingress of moisture and the effects of high temperature.

8.6 Interruption of the electricity supply

8.6.1 In the event of the electricity supply to water level and firing control equipment being interrupted or failing, the fuel and air supply to the burner should be cut off automatically. Restarting procedure on restoration of the mains supply should be subject to the same requirement as normal start-up for oil and gas burners. Start-up for solid fuel burners will depend on the system installed. Interruption and subsequent restoration of the electricity supply should not override any lock-out condition which existed prior to the mains supply failure or interruption.

8.6.2 In the event of a flame, pilot flame or ignition failure, the control system shall proceed to the lock-out condition.

8.7 Boilers using mixing valves

Where mixing valves are used to blend return water with flow water, solid fuel boilers should serve at least one circuit which is independent of the mixing valve and which is capable of dissipating residual heat in the fuel bed when the mixing valve closes against the boiler, e.g. during mild weather, otherwise a heat dissipation thermostat which will override the mixing valve control in the event of excessive temperature rise, should be fitted in the boiler flow line.

NOTE: The method for maintaining boiler circulation shall be considered for all operating conditions.

8.8 Safety valves

In all categories, a suitable safety valve shall be fitted on or as near as possible to the boiler. Safety valves should be sized and set in accordance with the relevant hot water boiler construction standard, such as BS 6759, BS 2790, BS 855 and BS 759. It shall not be possible to isolate the safety valve from the boiler.

8.9 Training

Controllers shall ensure that persons entrusted with the supervision of hot water boilers are familiar with the controls and the conditions for the safe working of the boiler and system. The amount of training required will depend on the extent and complexity of the plant and may require some input from the boiler manufacturer.

8.10 Testing and maintenance

- 8.10.1 Owing to the diversity of controls for fully flooded hot water boilers, it is not possible to give details of testing and maintenance in these notes. The boiler manufacturer's instructions or advice on regular testing and periodic maintenance and servicing shall be strictly followed. Servicing and maintenance by responsible and experienced personnel is essential to ensure that controls are kept in good working order.
- 8.10.2 It is recommended that a full inspection of pressure parts and controls be carried out at least annually, followed by testing of all safety systems on start-up.

PART 9: Unfired Waste Heat Boilers

In process industries, steam is often generated in heat exchangers, which perform the same function as boilers in generating steam.

9.1 Definition

An unfired waste heat boiler is a heat exchanger (boiler) that recovers heat from a gas stream. These boilers shall not be exposed to radiant heat or flame impingement.

9.2 Design

- 9.2.1 Where the design is such that the heat exchanger can operate safely under the most adverse conditions, without any water in it, then it may be designed to the unfired pressure vessel standards; ASME Section VIII, NZS BSPD 5500 or AS 1210, provided it falls within the ranges of temperatures permitted.
- 9.2.2 Unfired waste heat boilers that are not able to be run dry shall be designed to the appropriate approved boiler design standards.

9.3 Safety protection devices

- 9.3.1 Safety devices such as safety valves, blowdown valves and some means of measuring the water level are regarded as essential.
- 9.3.2 Where the design is such that the heat exchanger can operate safely under the most adverse conditions, without any water in it, then the requirements to fit all the safety devices according to this code may be relaxed.
- 9.3.3 Where the design is such that the unfired waste heat boiler cannot operate safely under adverse conditions (dry) then full safety protection devices shall be provided as listed:
 - (a) First low-water alarm and lock-out;
 - (b) Second low-water alarm and lock-out, internally mounted, self-checking and of special design;
 - (c) Feed water availability indicator and alarm;
 - (d) Feed water low-pressure or low-flow alarm;
 - (e) Steam temperature and pressure controls;
 - (f) Superheater and reheater temperature controls and alarms (for heaters with superheaters or reheaters); and
 - (g) Continuous automatic blowdown control (TDS control).

9.4 Special applications

- 9.4.1 Special-application unfired waste heat boilers that are outside the limits of this code will be assessed on their ability to guarantee equivalent levels of safety to be achieved within this code. Generally, for standard applications, these will be variations of water tube type boilers.

- 9.4.2 An inspection body shall determine the equivalence of any safety feature for a particular installation, to the ones required in this code.
- 9.4.3 A complete purge of the combustion turbine and portions of the heat recovery steam generator (HRSG) enclosure is necessary before light-off of the combustion turbine. The objective of this practice is to remove potential accumulations of hazardous unburned fuel that could be ignited by light-off of the combustion turbine. The reference in relation to detailed purging requirements for particular installation shall be made to NFPA 8506: Standard on Heat Recovery Steam Generator Systems.
- 9.4.4 If a condition arises where the heat source must be removed and the combustion turbine diverter valve is required to move from the "open-to-HRSG" to the "diverted" position, and the valve fails to operate, or only partially operates, then the combustion turbine shall shut down immediately.

APPENDIX A: Principal Standards Accepted for Use in New Zealand in Connection with Boilers

Wherever a Standard is referred to in this code, it shall be taken to be the latest issue and amendments of that Standard, unless otherwise specified.

A1. New Zealand Standards

NZS 5261 *Gas Installation.*

NZS 4203 *General structural design and design loadings for buildings.*

NZS BSPD 5500 *Specification for unfired fusion welded pressure vessels.*

NZS/BS 806 *Specification for design and construction of ferrous piping installations for and in connection with land boilers.*

A2. Joint Australian/New Zealand Standards

AS/NZS1200 *Pressure equipment.*

AS/NZS3788 *Pressure equipment - In-service inspection.*

ASNZS4481 *Pressure equipment - Competencies of inspectors.*

AS/NZS ISO/IEC 17020 *General criteria for the operation of various types of bodies performing inspection.*

A3. Australian Standards

AS 1228 *Pressure equipment-Boilers.*

AS 1210 *Pressure vessels.*

AS 2593 *Boilers – Safety management and supervision systems (see Appendix B of this code).*

AS 3873 *Pressure equipment - Operation and maintenance.*

AS 3892 *Pressure equipment - Installation.*

AS 4343 *Pressure equipment - Hazard levels.*

AS 4458 *Pressure equipment - Manufacture.*

AS 61508 *Functional safety of electrical/electronic/programmable electronic safety-related systems*

AS IEC 61511 *Functional safety – Safety instrumented systems for the process industry sector*

A4. British Standards

- BS 759 *Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers. Part 1 Specification for valves, mountings and fittings.*
- BS 799 *Oil burning equipment.*
- BS 855 *Specification for welded steel boilers for central heating and indirect hot water supply (rated output 44 kW to 3 MW).*
- BS 1113 *Specification for design and manufacture of water-tube steam generating plant (including superheaters, reheaters and steel tube economisers).*
- BS 2486 *Recommendations for treatment of water for steam boilers and water heaters.*
- BS 2790 *Specification for design and manufacture of shell boilers of welded construction.*
- BS 5410 *Code of practice for oil-firing.*
- BS 5885 *Automatic gas burners.*
- BS 5978 *Safety and performance of gas-fired hot water boilers (60kW to 2MW input).*
- BS EN ISO 4126-1 *Safety devices for protection against excessive pressure. Safety valves.*
- PM 60 *HSE Guidance Note: Steam boiler blowdown systems.*

A5. U.S.A. Standards

Designs of water tube boilers complying fully with the latest issue of the *Boiler and Pressure Vessel Code*, section I, "Power boilers" (including all amendments) published by the American Society of Mechanical Engineers, are acceptable subject to the conditions stated in this code.

- ASME *Boiler and Pressure Vessel Code, Section 7: Recommended Guidelines for the Care of Power Boilers.*
- ASME *Boiler and Pressure Vessel Code, Section 8-Division 1: Pressure Vessels Guidelines Basic Coverage, Division 2: Pressure Vessels Alternative Rules for Basic Coverage.*
- ASME B 31.1 *Power Piping.*
- National Fire Protection Association standards:
- NFPA 8501 *Standard for single burner boiler operation.*
- NFPA 8502 *Standard for the prevention of furnace explosions/ implosions in multiple burner boilers.*
- NFPA 8503 *Standard for pulverised fuel systems.*
- NFPA 8506 *Standard on heat recovery steam generator systems.*
- American Petroleum Institute publication:

A6. Miniature Boiler Standards (for information—not covered by the code)

Australian Miniature Boiler Safety Committee (AMBSC) Code - Part 1 and Part 2.

A7. Existing boilers

Any boiler designed and approved to an earlier issue and amendment of these standards should be maintained and repaired to the design issue. However, the advances in the engineering knowledge and experience reflected in the subsequent issues of the codes should be taken into consideration when carrying out the boiler maintenance.

Weld repairs and alterations of boilers designed to ASME Boiler and Pressure Vessel Code, Section I, may be carried out in accordance with the rules of the National Board Inspection Code, published by the National Board of Boiler and Pressure Vessel Inspectors.

APPENDIX B: Clauses from AS 2593: 2004 to be considered for Boiler Design Purposes

For the following points, not covered fully in this code, reference should be made to the clauses listed below from AS 2593.

Start gas rate

Clause 3.15.5 specifies requirements.

Main flame turn down and modulation

Clause 3.16.3 specifies requirements in detail.

Additional and specific requirements for oil-fired, gas-fired and solid fuel in suspension fired boilers

Clause 4.1 indicates requirements.

Additional and specific requirements for solid fuel fired (bed or grate) boilers

Clause 5.1 indicates requirements.

APPENDIX C: Information Needed by the Authority with First Application to Operate an Unattended or Limited Attendance Boiler

C1. Method of application for limited-attendance boiler operation and unattended boiler operation

The following documentation is required by the Authority in respect of any application to operate any boiler in the limited or unattended mode:

C1.1 *From the boiler manufacturer or person carrying out the conversion to limited or unattended operation, statements certifying that:*

- (a) The boiler has been designed and constructed in accordance with a specified and nominated standard listed in appendix A (including any supplementary requirements listed in appendix B).
- (b) The boiler and its boiler control system complies in full with the requirements of this code for limited-attendance operation, or, unattended operation, as the case may be.
- (c) Those persons who will be responsible for the maintenance of the boiler control system are familiar with the operation of the boiler and its control system and have been trained to a satisfactory level of ability in all those functions.
- (d) The training needs of the person responsible for operating the boiler have been identified, documented and supplied to the controller.
- (e) The criteria required to be met by the person responsible for maintaining the boiler control system have been identified, documented and supplied to the controller.

C1.2 *From the controller, statements certifying that:*

- C1.2.1 (a) The requirements applying in this code relating to the operation and maintenance of limited attendance boilers, or, unattended boilers (as the case may be) have been read and are fully understood.
- (b) The organisation undertakes to ensure that the boiler is operated and maintained at all times in accordance with the requirements of this code.
- (c) Those persons responsible for the operation of the boiler have been trained to the extent necessary to satisfy the training needs specified by the boiler manufacturer.
- (d) Those persons responsible for the maintenance of the boiler control system have been trained to the extent necessary to satisfy the training needs specified by the boiler manufacturer.
- (e) The organisation undertakes to operate the boiler in accordance with a quality management system that meets the requirements of this appendix.

- (f) The organisation undertakes to maintain, internally audit, continuously review and seek to improve the operation and maintenance system relating to that boiler in consultation with the boiler manufacturer.

C1.2.2 The following additional documents are required from the controller in support of the above statements:

- (a) Prior to operation, during any period of interim arrangement agreed by the Authority (which shall not exceed one year):

- (i) If the quality management system applies to boilers with an aggregate power greater than 6 MW:

An undertaking that, during the agreed period, the system will be brought up to the full standard required by a certification body.

- (ii) If the quality management system applies to boilers with an aggregate power not exceeding 6 MW:

A copy of an interim document issued by an inspection body stating that the quality management system is installed to its complete satisfaction, has been examined and that it is considered to make adequate provision for all essential safety purposes for the duration of the agreed period.

- (b) Prior to operation, following any period of interim arrangement agreed by the Authority:

- (i) For limited-attendance and unattended boilers with an aggregate power greater than 6 MW:

A copy of an AS/NZS ISO 9001:2000 quality management system certificate from a certification body, complete with any schedules to that certificate.

- (ii) For limited and unattended boilers with an aggregate power not exceeding 6 MW:

A copy of a document issued by an inspection body certifying that the operation and maintenance system complies with the essential requirements of AS/NZS ISO 9001:2000 in respect of the safe operation and maintenance of the boiler as is required by this code. The inspector must certify that the operational and maintenance system has been established to the inspection body's complete satisfaction, has been audited and that it is considered to make adequate provision for all safety purposes; or

A copy of an AS/NZS ISO 9001:2000 quality management system certificate from a certification body, complete with any schedules to that certificate.

C1.3 From the inspection body, statements certifying that:

- C 1.3.1 (a) The boiler design has been verified as complying with the requirements of the design standard and that the seismic requirements have also been considered and verified.

Note: This statement shall be signed for the inspection body by an approved design verifier.

- (b) The design of the boiler control system and its components have been verified and that they comply in full with the requirements of this code for limited or unattended operation as the case may be.
- (c) The boiler has been fully tested under operating conditions and that it performs in all respects with the requirements of this code and that the boiler is considered safe to operate as a limited attendance boiler or an unattended boiler, as the case may be.

NOTE: The boiler shall not be tested until the information described in clauses C1.3.1(a) and C1.3.1(b) above has been reviewed by the equipment inspector. Statement C1.3.1(c) shall be signed for the inspection body by an equipment inspector with skills related to the boiler and boiler control systems.

C 1.3.2 These statements shall be forwarded by the equipment inspector involved, on completion of the testing described in clause C1.3.1(c) above, to Engineering Safety Group of OSH to enable the exemption (see 1.33) to be progressed.

C1.4 Renewal

Exemptions (see 1.33) may be renewed by the Authority on reconfirmation from the controller of all the statements in clause C 1.2 above. The Authority will want to see a copy of the current AS/NZS ISO 9001:2000 certificate or a copy of the document issued by the inspection body and the current certificate of inspection or inspection report for the boiler.

C2. Operation and maintenance

C2.1 Limited-attendance or unattended boilers with an aggregate power not exceeding 6 MW may be operated and maintained using a documented operation and maintenance system other than one which is a full implementation of AS/NZS ISO 9001:2000.

Such an operation and maintenance system shall contain all the essential elements of AS/NZS ISO 9001:2000 and shall be subject to approval and audit by an inspection body.

"Operation and maintenance system" in relation to the operation, maintenance, repair and testing of the boiler, shall include:

Management and organisation:

Who reports to whom. What the accountabilities and responsibilities of each person are, including any limitations. Who supervises whom. Who conducts the internal audits of the system and how any shortcomings are to be rectified and by whom.

Staff training:

Full details of the training system given to those responsible for operating and maintaining the boiler, including any appropriate qualifications. Details of who conducts the training and how its effectiveness is monitored.

Operation and maintenance:

Full details of the procedures for operating the boiler. What action is to be taken when alarm indications arise. Full details of the procedures for testing and treating

the boiler and feed water. Full details of the procedures for testing the boiler equipment and its safety functions. Full details of the maintenance contract for the boiler control system. Full details of how faults and defects are to be reported, recorded, rectified and tested.

Documents and records:

Instructions, test and calibration reports and records, lab reports, maintenance and repair records.

- C2.2 In the case of limited attendance or unattended boilers with an aggregate power greater than 6 MW, the controller may seek from the Authority permission to operate the boiler(s) in limited attendance or unattended operation for a limited period (which shall not exceed 12 months) until a system, which has the approval of and is under the audit of a certification body, is fully operational.
- C2.3 Such quality management systems authorised under the provisions of clause C2.2 shall be under internal audit by the controller and external audit by the inspection body, or by a certification body.

Note: In such cases, the owner shall ensure when engaging a certification body, that a representative of the Authority is given opportunity to take part in the audit.

APPENDIX D: Guidelines for the Design Verification of Boiler Control Systems (BCS)

The guidelines for boiler control systems design verification recognise their complexity and allow for situations where effective verification may require works testing and the services of hardware and software specialists who may not normally be on an inspection body's staff.

D1. Type acceptance of boiler controls

Inspection bodies providing design verification services for boilers may, in addition to issuing design verification certificates for 'one-off' boilers, issue a type acceptance for serially produced equipment including boiler controls.

This type acceptance would be specific to the organisation which sought it. Type accepted controls may then be applied to boilers conforming with the acceptance criteria.

For boiler controls, type acceptance would be for a discrete control or control assembly, not some minor component.

D2. Documentation and design statements

When obtaining a design verification certificate from an inspection body for a complete boiler or a BCS type acceptance, the boiler manufacturer's submission to the inspection body, relating to the BCS, shall include:

- (a) A schedule of boiler controls to be installed and sufficient technical data for the inspection body to verify that these controls are in accordance with this code;
- (b) A fully comprehensive functional description of the BCS logic applicable to the boiler controls;
- (c) A statement that the BCS—including hardware, software and associated field equipment—has been designed and will be installed in accordance with provisions of this code and that under all conditions in which:
 - (i) operational control or safety in the terms of this code may be compromised; or
 - (ii) a system fault has occurred in a critical component of the BCS or its associated field equipment;the controls will 'fail safe' and, when appropriate, the boiler fuel and air supply will be cut off; and
- (d) A statement that a detailed technical review of the complete BCS has been carried out by personnel, having appropriate skills and experience, and being independent of the design process for the BCS.

D3. The use of boiler safety controls not covered by an 'applicable standard'

In order to be approved by an inspection body, boiler safety controls should comply with a recognised 'applicable standard'.

However, in cases where there is no recognised 'applicable standard', the boiler manufacturer shall obtain sufficient technical data from the controls manufacturer to establish that the control would be appropriate for the particular application. This information may be obtained from technical data in the controls manufacturer's catalogue or in a detailed technical statement from the controls manufacturer.

In either case, it is the boiler manufacturer's responsibility to ensure that the quality of the data provided is satisfactory and, on the basis of the technical data provided by the manufacturer, that the control will be appropriate for the particular application.

D4. Design verification of boiler safety controls

An inspection body shall, as a part of the overall design verification process for the boiler:

- (a) Verify that all boiler safety controls required have been provided;
- (b) Verify that all boiler safety controls have been designed and manufactured to a recognised 'applicable standard' and are appropriate for the boiler or, are covered by data provided by the controls manufacturer, from which it would have been reasonable for the boiler manufacturer to conclude that the controls have been designed and manufactured to a standard appropriate for the boiler; and
- (c) Verify that the functionality of the boiler safety controls, as described by the boiler manufacturer, is appropriate for the particular boiler.

Appendix E: Commissioning Test of Boiler Control System for Limited Attendance and Unattended Boilers

See check-sheets on the following pages.

Table E1: Commissioning Test of Boiler Control System for Limited Attendance and Unattended Boilers

Unique Identifier: Manufacturer/ Installer:

Boiler type: Contoller:

..... Address:

MW rating: Design Verification Certificate No. & Date:

Steam output: kg/hr Inspection Body & Design Verifier's Name:

Pressure: bar

Fuel: Inspection Body & Equipment Inspector's Name:

Max. temperature: °C

We confirm that the following boiler commissioning tests have been carried out in accordance with the requirements of the above design verification certificate:

Corresponding Clause	Requirement	Description	Manufacturer/ Installer's Signature	Equipment Inspector's Signature
3.1.1.1(d) / 5.2.1.1(d)	Feedwater low-pressure or low-flow lock-out and alarm			
3.2 / 5.3	First low water lock-out and alarm			
3.3 / 5.4	Second low-water lock-out and alarm, independent of first lock-out			

Corresponding Clause	Requirement	Description	Manufacturer/ Installer's Signature	Equipment Inspector's Signature
3.1.1.1(b) & (f) 5.2.1.1(b) & (f)	Second low-water lock-out and flame detector(s) to be hardwired			
3.4 / 5.5	Feedwater control			
3.5 / 5.6	Feedwater availability cut-out and alarm			
3.6 / 5.7	Feedwater low-pressure alarm			
5.2.1.1(g)	Automatic continuous blowdown control (TDS control)			
5.2.1.1(h)	Steam limiting valve			
3.1.1.2(b) / 5.2.1.2(a)	Superheater and reheater pressure/temperature controls and alarms			
3.1.1.2(c) / 5.2.1.2(b)	High-level cut-out and alarm			
3.1.1.2(d) / 5.2.1.2(c)	Condensate oil and turbidity detector and alarm			
3.1.1.2(e) / 5.2.1.2(d)	Feedwater monitoring alarm (e.g. conductivity) and diversion			
3.8.1(a) 5.9.1(a)	Flame/pilot flame failure			
3.8.1(b) 5.9.1(b)	Failure to ignite fuel within a predetermined time			

Corresponding Clause	Requirement	Description	Manufacturer/ Installer's Signature	Equipment Inspector's Signature
3.8.1(c) 5.9.1(c)	High drum pressure			
3.8.1(e) 5.9.1(e)	Failure of fan or automatic flue damper			
3.7 / 5.8	Failure of forced circulation			
3.9 / 5.10	Combustion chamber thermal cut-out and alarm			
1.14	Two independent means of indicating the water level			
1.15.3	Safety valve discharge capacity			
1.15.4	Safety valve accumulation test			
1.16.2	Calibration of pressure gauge			
3.14.3.6 / 5.15.3	Auto start and operation of standby feed pump (both ways)			
1.21.2	Main isolator or emergency stop - shuts down burner but allows alarms to operate			
1.21.4 / 1.21.7	Safe shut down on power failure - or back-up power supply. Uncorrected faults indicated on restoration of power			

Corresponding Clause	Requirement	Description	Manufacturer/ Installer's Signature	Equipment Inspector's Signature
1.22.6	Power-operated valves to fail-safe			
1.23.2	Audible and visual alarms			
1.23.4	Alarms can be seen and/or heard			
1.23.5	Visual alarms not extinguished			
1.23.6	Alarms distinguishable			
1.23.7	Identify individual alarms			
1.23.8	Acknowledgement of visual alarms			
1.23.9	Alarms in boiler house still operate on remote acknowledgement of alarms			
1.23.10	Additional alarms indicated if boiler shut down on the primary fault			
1.23.11	Alarms lock-in			
1.23.12	Alarm test functions			
1.23.13	Alarms, as designed, are independent of controls			
1.23.18	Alarm settings identified			

APPENDIX F: Boiler Ratings

There are three commonly used types of boiler ratings in New Zealand. These are:

- (a) Boiler output rating "kW";
- (b) "From and at" evaporative capacity rating; and
- (c) Boiler "horsepower rating".

NOTE: The examples of boiler ratings' calculation here are provided for the purpose of illustration only. Responsibility for calculating boiler rating of a particular boiler remains with the boiler designer.

F1. Boiler output rating

The boiler output rating (capacity) will often be given as the rate of heat transfer to the feedwater in kilowatts (kW) or megawatts (MW);

$$P = Q \times (h_{go} - h_{fi}) \text{ [kW]}$$

where the following symbols apply:

P - boiler output rating (kW = kJ/s),

Q - boiler evaporative capacity (kg/s),

h_{go} - specific enthalpy of steam/water at boiler outlet conditions (kJ/kg),

h_{fi} - specific enthalpy of feedwater at boiler inlet conditions (kJ/kg).

For the boiler installations comprising superheaters, the heat added to the medium in the boiler shall be calculated as the sum of latent heat and superheat.

Example 1: Watertube boiler with superheater

The boiler characteristics

Boiler feedwater inlet temperature:	145°C
Feedwater saturation temperature:	262°C
Superheated steam outlet characteristics:	4300 kPa(a) /425°C
Boiler evaporative capacity Q:	80000 kg/h

Known parameters (steam tables)

Feedwater saturation pressure @ 262°C:	4850 kPa(a)
Specific heat of water H_s	4.2 kJ/kg/°C
Specific enthalpy of superheated steam h_g :	3265 kJ/kg
Specific enthalpy of water @ 4850 kPa(a) h_f :	1145 kJ/kg

Calculation

The heat transfer rate is calculated as the sum of latent heat and superheat added to the feedwater.

The latent heat from feedwater inlet through to the saturation is calculated as follows:

$$H_1 = Q \times H_s \times \Delta T$$

$$H_1 = [80000(\text{kg/h}) \times 4200 (\text{J/kg/}^\circ\text{C}) \times (262 - 145) (^\circ\text{C})] / 3600(\text{s/h})$$

$$H_1 = 10.9 \text{ MJ/s}$$

The superheat added is calculated as follows:

$$H_{\text{sh}} = Q \times (h_g - h_f)$$

$$H_{\text{sh}} = [80000 (\text{kg/h}) \times (3265 - 1145) (\text{kJ/kg})] / 3600 (\text{s/h})$$

$$H_{\text{sh}} = 47.1 \text{ MJ/s}$$

The total heat transfer rate within the boiler is:

$$H = H_1 + H_{\text{sh}}$$

$$H = 10.9 + 47.1 = 58 \text{ MJ/s}$$

So, the output rating of this boiler is $P = 58 \text{ MW}$

To establish the actual evaporation by mass from a given power rating, it is necessary to know the heat content of the feedwater and the total enthalpy of the steam produced, in order to establish how much energy is added to each kilogram of water.

Note: The simplified calculation method used here assumes that the specific heat remains constant at $4.2 \text{ kJ/kg/}^\circ\text{C}$. An alternative calculation method, using the difference between outlet enthalpy and inlet enthalpy multiplied by the steam flow, would produce a similar boiler rating of 59 MW .

Example 2: Shell boiler

A shell boiler has output rating of $P = 3 \text{ MW}$ and operates at 1000 kPa with a feedwater temperature of 50°C .

A feedwater temperature of 50°C means a specific enthalpy of water of $h_{fi} = 209.5 \text{ kJ/kg}$.

Saturated steam at 1000 kPa requires heat input of $h_{go} = 2781.7 \text{ kJ/kg}$.

Hence to produce this result the boiler fuel needs to transfer to the water the difference of $(h_{go} - h_{fi}) = 2781.7 - 209.5 = 2572.2 \text{ kJ/kg}$.

Boiler evaporative capacity in kg/in of steam is then;

$$Q = P / (h_{go} - h_{fi})$$

$$Q = 3000 (\text{kW}) \times 3600 (\text{s/h}) / 2572.2 (\text{kJ/kg})$$

$$Q = 4198.7 \text{ kg/h}$$

F2. "From and at" evaporative capacity rating

The "from and at" method of rating capacity is widely used by shell boiler manufacturers. It expresses the boiler output in terms of equivalent evaporative capacity at reference conditions;

$$Q_{\text{"f&a"}} = P / h_{fg}(\text{ref}) [\text{kg/s}]$$

where the following symbols apply:

P - boiler output rating (kW),

h_{fg} - specific enthalpy of evaporation at reference conditions
- typically 100°C / 0 kPa (kJ/kg),

Note that this does not equal the actual evaporative capacity, which can be determined from:

$$Q = Q_{f\&a} \times h_{fg}(\text{ref}) / (h_{go} - h_{fi})$$

F3. Boiler "horsepower rating"

The "horsepower" unit rating tends to be used only in the USA, Australia and New Zealand. It is actually not a "power" rating.

In New Zealand it is a measure of the heat transfer surface of the boiler, where;

$$*1 \text{ Horse Power} = 17\text{ft}^2 (1.579 \text{ m}^2) \text{ of heating surface}*$$

Hence, the conventional power conversion factors **ARE NOT APPLICABLE**.

It is arguable, that this type of boiler rating is somewhat inaccurate, as with the constant value of heating surface area, the needed heat transfer is also dependent on the temperature difference and the heat transfer coefficient in the heat transfer model applicable. However, a particular boiler's output rating shall be specified by the boiler manufacturer from design calculations.

APPENDIX G: Conformity Assessment

G1. Introduction

- G1.1 This appendix specifies the conformity assessment requirements for pressure equipment coming within the scope of the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999.
- G1.2 Conformity assessment shall include design verification and fabrication inspection.
- G1.3 Conformity assessment shall be performed as indicated in Table G 1 by either an inspection body or within the designer's/manufacturer's quality management system as appropriate.

Table G1: Pressure equipment conformity assessment

Hazard level of equipment to AS 4343	DESIGN		FABRICATION	
	Management system	Inspection body	Management system	Inspection body
A	QMS (AS/NZS ISO 9001:2000)	Yes	QMS (AS/NZS ISO 9001:2000)	Yes
B	QMS (AS/NZS ISO 9001:2000)	Yes	QMS (AS/NZS ISO 9001:2000)	No
	No QMS	Yes	No QMS	Yes
C	QMS (AS/NZS ISO 9001:2000)	No	QMS (AS/NZS ISO 9001:2000)	No
	No QMS	Yes	No QMS	Yes
D	QMS (AS/NZS ISO 9001:2000)	No	QMS (AS/NZS ISO 9001:2000)	No
	No QMS	Yes	No QMS	No
E	No QMS	No	No QMS	No

NOTES:

- 1 "QMS" means Quality Management System.
- 2 "Yes" indicates that design verification/fabrication inspection is required by an AS/NZS ISO/IEC 17020 accredited inspection body. This may be a Type "A", "B" or "C" inspection body.
- 3 "No" indicates that design verification/fabrication inspection may be performed within the designer's/manufacturer's QMS as appropriate.

Where a QMS is required as the alternative to engagement of an inspection body, then any person performing conformity assessment activities within such a QMS must be the holder of relevant certificate of competence issued by a recognised qualification issuing agency. This provision does not apply to the fabrication inspection of equipment of hazard level D and E.

G2. Inspection bodies

- G2.1 Inspection bodies providing conformity assessment services shall be recognised by the Secretary and accredited to AS/NZS ISO/IEC 17020 with an appropriate accreditation scope.
- G2.2 Inspection bodies shall only provide conformity assessment services permitted by their accreditation type and scope.

G3. Quality management system

- G3.1 A designer or manufacturer may provide conformity assessment within their quality management system as per Table G1. Such a quality management system shall be certified to AS/NZS ISO 9001:2000, and shall be recognised by OSH—Engineering Safety. Equipment designers/manufacturers shall provide these conformity assessment services only for equipment they design and/or manufacture.
- G3.2 OSH must have been given the opportunity to participate in assessments of the designer's/manufacturer's management system carried out by the certification body.
- G3.3 The designer's/manufacturer's management system must include procedures acceptable to OSH for ensuring that:
- (a) Persons employed on design verification or fabrication inspection duties are appropriately qualified and experienced;
 - (b) Quality assurance work is carried out in an objective fashion; and
 - (c) QA management have an independent reporting path to the chief executive.
- G3.4 Following ISO certification, designers/manufacturers must obtain an exemption under regulation 5 of the PECPR Regulations before carrying out any in-house conformity assessment permitted by this appendix. This conformity assessment shall only be performed for equipment which they design/manufacture.

G4. Design verification

G4.1 General

- G4.1.1 Boiler design shall be verified for compliance with the applicable standards and this code. Design verification shall also include any requirements specified by the purchaser which are relevant to the safety of the equipment.
- G4.1.2 Design verification may also include other verification work by agreement with the purchaser provided this does not compromise the validity of the design verification process.
- G4.1.3 Design verification shall have regard for any circumstances which may reasonably be expected to arise in relation to the equipment so that when the equipment is properly maintained it remains safe for persons who operate or maintain it or who may otherwise be in its vicinity.
- G4.1.4 Unless otherwise specified by the inspection body or, affected by G4.5, more than one item of equipment may be manufactured from a verified design.

G4.2 Design documentation

The design submission for verification shall contain the following:

- (a) Three copies of drawings showing the design conditions, hazard level, design standard, class of construction, boiler rating, essential dimensions, material specifications of all component parts, weld details, location of connections and openings, supports and other details considered by the design verifier to be necessary for design verification, lifting facilities and transport requirements;
- (b) A copy of design calculations including all specified design conditions;
- (c) Any other data necessary to assist with verification of the design (e.g. service conditions and valve and fittings specifications);
- (d) Where relevant to verification the applicable parts of the purchaser's specification; and
- (e) Manufacturing and test plan.

G4.3 Extent of design verification

The following aspects of design shall be included in design verification:

- (a) Suitability of materials for service;
- (b) Adequacy of all pressure parts for design operating conditions including the effect of pressure, temperature, externally applied loads and local environmental conditions such as seismic disturbances and wind, snow and ice;
- (c) Manufacturing and testing requirements including the inspection and test plan;
- (d) Specifications for flanges, valves and fittings;
- (e) Transportation and erection plans and procedures;
- (f) Equipment design life including the procedure to be followed when the end of any finite life is reached;
- (g) Equipment supports not covered by G4.6; and
- (h) Where appropriate any other aspects of design affecting boiler safety.

G4.4 Programming of design verification

Design shall be verified before the commencement of manufacture except where the manufacturer:

- (a) Accepts the risk of future rejection of the design including any rework of design, equipment manufacture and inspection and testing that may be necessary subsequent to completion of design verification;
- (b) Ensures that all tests and inspection are carried out in accordance with the relevant standard and specification; and
- (c) Makes all necessary documentation available to the inspection body.

G4.5 Alterations requiring design verification

G4.5.1 Boilers under manufacture or existing equipment which is altered as described below, shall be treated as a new design and submitted for design verification:

- (a) The materials of construction or the design of pressure or structural parts of the equipment are modified. Depending on the nature of any modification it may be necessary to re-verify the affected components or the whole design.
- (b) The standard on which verification was based is revised or withdrawn prior to commencing manufacture of the equipment. The effective date of any such change shall be in accordance with the standard's requirements for implementation. Equipment contracted for prior to a standard being revised may be manufactured to a design verified in accordance with the issue of the standard at acceptance of tender. However, the parties to the contract may agree that the equipment should incorporate any revisions subsequent to the issue of the standard on which the contract was based. Where appropriate, such revisions shall be subject to design verification by an inspection body.
- (c) There is any change to the design operating parameters which would adversely affect the boiler's safety. Re-verification may be required if the operating pressure, temperature or firing conditions are changed.
- (d) There is any change to the design operating environment which would adversely affect the equipment.
- (e) Re-verification may be required if the equipment is to be relocated to another seismic zone.
- (f) Other alterations which may affect the health and safety of personnel.

G4.5.2 Re-verification of a water tube boiler design shall be necessary in the event of any of the following modifications:

- (a) Increase in boiler output rating, pressure, outlet temperature, or combustion chamber gas temperature.
- (b) Changes in material thickness or quality.
- (c) Any dimensional changes to drums, headers, risers, downcomers, water tubes, superheaters, economisers, combustion chambers, or their position or number.
- (d) Alteration of any manhole frame or standpipe compensation.
- (e) Changes in fuel.

G4.5.3 Re-verification of a shell boiler design shall be necessary in the event of any of the following modifications;

- (a) Increase in boiler output rating, pressure and outlet temperature or combustion chamber gas temperature.
- (b) Changes in material thickness or quality.
- (c) Any dimensional changes to shell, end plates, furnaces, furnace stiffeners, wet back combustion chambers, compensation plates, gusset stays, stay bars, stay tubes or smoke tubes or their position or number.
- (d) Alteration of any manhole frame or standpipe compensation.

(e) Changes in fuel.

G4.6 Foundations and supports

The design and construction of boiler foundations and building structures supporting boilers shall be certified by a Chartered Professional Engineer.

G4.7 Boiler control system

Guidelines for the design of boiler control system are given in appendix D of this code.

G4.8 Design verification certificate

- G4.8.1 The contents of a Certificate of Design Verification shall be as required by Regulation 31 of the Health and Safety in Employment (Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999.
- G4.8.2 The design verification certificate shall be signed by the design verifier and shall identify the accreditation body.
- G4.8.3 A design verification certificate is valid from its date of issue. It is not valid for a particular boiler if any of the conditions in G4.5 arise.
- G4.8.4 If the design standard on which design verification was based is revised or withdrawn prior to commencing manufacture of the equipment a new design shall be submitted for design verification in accordance with the standard's requirements for implementation of any such revision. Equipment contracted for prior to a standard being revised may be manufactured to a design verified in accordance with the issue of the standard at acceptance of tender. However, the parties to the contract may agree that the equipment should incorporate any revisions subsequent to the issue of the standard on which the contract was based. Where appropriate such revisions shall be subject to design verification by an inspection body.

G5. Fabrication inspection

G5.1 General

- G5.1.1 Fabrication inspection shall be performed on pressure equipment under manufacture to establish compliance with the design standard and this code. It shall include any inspection requirements specified by the purchaser which are relevant to the safety of the boiler.
- G5.1.2 Fabrication inspection may also include other inspection work agreed between the purchaser and the inspection body provided this does not affect the integrity of the inspection process.

G5.2 Facilities

- G5.2.1 The fabrication inspector shall be given access to equipment in the manufacturer's works and to equipment under erection. The fabrication inspector shall be permitted to inspect equipment under manufacture or erection at any stage.
- G5.2.2 The manufacturer shall ensure that materials and equipment are in suitable condition and accessible at any time agreed for inspection.
- G5.2.3 The manufacturer shall agree to a reasonable notice period with the fabrication inspector prior to reaching any stage of inspection.

G5.3 Extent of fabrication inspection

Fabrication inspection shall include, as applicable, the following inspection and test plan:

- (a) Checks that the manufacturer has acceptable manufacturing, inspection and test techniques and that appropriate procedures are followed.
- (b) A check that design verification has been performed and that verified documents are available at least prior to completing the manufacturer's data report. (See G4.5). Ideally, the verified drawings should be available during manufacture. Any equipment manufactured prior to verified drawings being available must be inspected. If there is any deviation, the equipment must be reworked to conform to the verified drawings.
- (c) Inspection of materials to establish compliance with material certification and design requirements.
- (d) Inspection of pressings, forgings and castings to establish compliance with relevant material specifications, pressure equipment standards and design requirements.
- (e) Inspection of weld preparation, shape, fit up and cleanliness of parts to establish compliance with design requirements and the applicable standard.
- (f) Checks of welding and brazing procedures to establish they are qualified in accordance with the applicable standard.
- (g) Checks to confirm that welders and brazers are qualified in accordance with the applicable standard.
- (h) Inspection to establish that the specified welding procedures are being used.
- (i) Inspection to establish that required heat treatment has been performed.
- (j) Inspection to establish that required production test welds are carried out and the results acceptable.
- (k) Inspection to establish that required non-destructive examinations and other tests have been performed and the results acceptable.
- (l) Inspection to establish that material, weld and other imperfections repaired by welding have been acceptably repaired.
- (m) Inspection of equipment to establish that thicknesses, surfaces and shapes are in compliance with design requirements and applicable standard.

- (n) Witnessing hydrostatic or pneumatic tests for compliance with the relevant pressure equipment standard.
- (o) Performing internal and external dimensional checks to ensure compliance with tolerances specified in the relevant pressure equipment standard and design documents.
- (p) Inspection to establish that equipment stamping and nameplate markings comply with the applicable standard and the requirements of this code.
- (q) Review and signing of the completed manufacturer's data report and inspection and test plan on completion of manufacture.
- (r) Inspecting and testing the type and installation of protective fittings for compliance with the relevant pressure equipment standard.
- (s) Any other inspection which is necessary to establish compliance with the applicable standard, this code and to ensure safety.

G5.4 Manufacturers data report

- G5.4.1 The manufacturer shall complete a declaration of conformity. The declaration of conformity shall be in accordance with the requirements of the manufacturing standard.
- G5.4.2 The declaration of conformity shall be signed by the equipment inspector. Where inspection was carried out under a manufacturer's management system the manufacturer's quality assurance manager shall sign the declaration of conformity.

APPENDIX H: Accident Notification (No Serious Harm)

The *Health and Safety in Employment (Pressure Equipment, Cranes, and Passenger Ropeways) Regulations 1999* requires, in regulation 9, that where a boiler incident occurs which may have an adverse effect on the safety of the boiler, certain actions have to be taken. These actions are:

- (a) Notify the Secretary as soon as possible after the event;
- (b) Have an investigation of the circumstances of the incident carried out by a Chartered Professional Engineer or an inspection body; and
- (c) Within 7 days of the incident, give the Secretary a detailed written report resulting from the investigation.