Guidelines for the integrity management of valves for the upstream and downstream industries

energy institute

GUIDELINES FOR THE INTEGRITY MANAGEMENT OF VALVES FOR THE UPSTREAM AND DOWNSTREAM INDUSTRIES

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FOREWORD

Valves have been an integral part of both high hazardous and general processing plant and equipment for many years. As with all work equipment, continued safe use and integrity need to be assured throughout the life cycle of the valve.

Guidance for the maintenance and integrity of valves within the hazardous processing industries has been relatively limited, often reliant solely on that produced by the original equipment manufacturer.

This Energy Institute (EI) publication brings together a wide range of knowledge, experience and expertise from all parts of industry as a working group for this document. The working group consisted of representation from the valve manufacturing industry and their industry body, the British Valve and Actuator Association, valve service providers, the regulator and end-users.

This guidance will provide upstream and downstream end users with information to develop suitable and sufficient maintenance strategies to ensure that valves are maintained in efficient working order and good repair to enable them to safely perform to their original design intent.

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This first edition guidance was coordinated and managed by Dr Cameron Stewart (EI) Upstream Technical Manager and Toni Needham (EI) Downstream Technical Manager.

1 INTRODUCTION

1.1 INTRODUCTION

Valves are types of work equipment which have been designed to both contain pressure and control fluid movement. This control can be achieved by opening, closing or partially obstructing the passage of the fluid flow, or by diverting or mixing the fluid flow.

In addition to the valves themselves, associated equipment such as actuators and gearboxes are also used. Within the context of this guidance document the term 'valve' also includes actuators, gearboxes and ancillary equipment associated with the valve (see Figure 1).

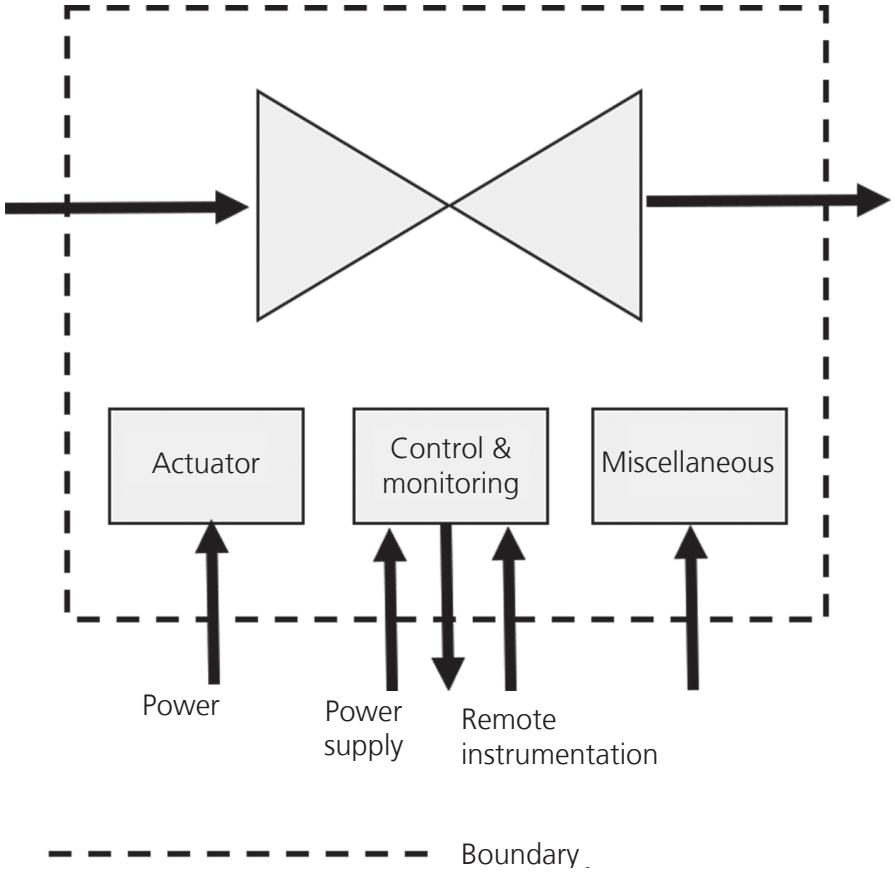

Figure 1: Equipment boundary

There is a wide variety of different valves available, and these differ according to a range of criteria including their type, size, pressure class, and material of construction. They also vary based on the application i.e. on/off or control. This means that different valves are suitable for different uses.

Valves are used throughout the upstream and downstream industries, and experience has shown that valves degrade due to a range of typical mechanisms including:

– corrosion;
– erosion;
– seal and seat deterioration e.g. 'wire drawing';
– scoring (sand or other contaminants);
– vibration fatigue;
– valve stem or shaft damage;
– cavitation of control valves, and
– waxing (build-up of organic deposits that block the valve).

See Annex C for more details.

As such, the integrity management of valves should be a key aspect of each organisation's overall integrity management requirements. Within the context of this guidance document, integrity management of valves includes the need to maintain:

– containment of the fluid under pressure;
– the required function of the valve, and
– the operability of the valve.

Valve failure can therefore be divided into three areas:

– Loss of integrity (pressure containment) – catastrophic or progressive failure of the valve body, seals or external parts, leading to leakage or pressure release.
– Loss of intended function – failure to operate, clogging or damage to valve internal parts.
– Component wear – wear or damage to internal parts due to erosion, corrosion, vibration or other causes.

However, it should be noted that failure in one area could lead to failure in other areas.

The upstream and downstream industries have identified that there are some limitations with the existing codes relating to valve integrity, in particular that in some cases they do not provide sufficient practical (as opposed to technical) guidance for the integrity management of valves as they are used in the upstream and downstream industries.

In addition, the industry has highlighted that there have been common valve integrity management issues identified which industry should be addressing.

1.2 SCOPE

This guidance has been written to support valve integrity management for the top-side activities of both the upstream and downstream petroleum industries. This includes hydrocarbon and hazardous systems, critical utilities, fire systems, and steam.

The guidance covers the following valve types:

- gate valves;
- globe (on/off) valves;
- diaphragm and pinch valves;
- plug valves;
- ball valves;
- butterfly valves;
- globe and angle control valves;
- choke valves, and
- self-acting regulating valves.

However, the guidance does not consider certain valve types and applications, including:

- subsea valves;
- Pressure Safety Valves (PSVs) as these are already well described in existing guidance;
- valves used in cryogenic systems;
- valves used in exploration wells, and
- valves used as part of well completion or 'Christmas trees'.

This document is not intended as a design guide for valves, but as guidance for how to manage integrity throughout the life cycle of a valve in service including:

- specification and selection;
- installation and commissioning;
- operation;
- maintenance, inspection condition monitoring and proof testing, and
- remedial actions.

However, there are numerous international specifications and standards which should be referred to when designing and selecting suitable valves.

It also aims to provide guidance on issues such as:

- knowledge, training and understanding;
- management of change (MoC);
- Safe Systems of Work (SSOW), and
- lessons learned and agreed good practices.

It is not the intent of this document to replace or conflict with existing technical standards or guidelines, but rather to guide the user to develop a process which manages valve integrity in practice.

1.3 APPLICATION

This document aims to provide good practice guidance to support organisations to develop their valve integrity management arrangements such that they suitably and sufficiently protect:

– people;
– the environment;
– assets, and
– production.

A further aim of this guidance is to encourage organisations to identify and share valve integrity management issues so that broader data sources can be developed, leading to the identification of industry-wide trends. This will also reduce the likelihood of repeat events across organisations through continuous improvement.

It should be noted that while this document aims to provide good practice guidance, every installation is different, and the specific circumstances of each valve should therefore be considered by the organisations involved. These considerations should take full account of the relevant current legislative and regulatory requirements, and also any related guidance.

The target audience for this guidance document are personnel working within top-side activities of both the upstream and downstream petroleum industries including:

– site managers;
– supervisors;
– technicians;
– operators;
– process system designers, and
– valve manufacturers and suppliers.

1.4 DOCUMENT OVERVIEW

Section 1 – provides an introduction to the guidance along with a description of its scope and application.

Section 2 – sets out an overview of the range and type of valves and actuators, along with definitions for the various components that make up a valve. It also sets out the various functions that valves perform and the relationship between these functions and the types of valves.

Section 3 – considers key aspects associated with valve specification and selection. This includes physical considerations, design/operational considerations and commercial considerations.

Section 4 – covers key issues regarding the installation and commissioning of valves. This includes pre-installation issues (such as storage), installation issues (such as installation planning) and post-installation issues (such as commissioning).

Section 5 – sets out significant aspects associated with the operation of valves, including the planned operation, the actual operation and the maloperation of valves.

Section 6 – considers the maintenance, inspection, condition monitoring and proof-testing of valves. This considers reactive and planned approaches and types of non-destructive testing (NDT).

Section 7 – identifies types of remedial action including replacement, overhaul, modification and repair.

Section 8 – covers the need to ensure suitable knowledge, training and understanding for employees, contractors and suppliers. It also considers human failures and human factors and the need to maintain corporate knowledge.

Section 9 – considers the need to manage lessons learned and agreed good practice, such as identifying and trending failures. This section also highlights some common lessons learned.