Guidance on applying a creeping change hazard identification (CCHAZID) methodology

energy institute

GUIDANCE ON APPLYING A CREEPING CHANGE HAZARD IDENTIFICATION (CCHAZID) METHODOLOGY

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Dr Mark Scanlon managed the project and edited this technical publication.

FOREWORD

Creeping changes are a safety, environmental and business risk that have only relatively recently been highlighted as a significant issue. The Health and Safety Executive's (HSE's) Key Programme 4 (KP4) covering the ageing and life extension (ALE) challenges facing hydrocarbon exploration and production installations on the UK's Continental Shelf (UKCS) identified creeping changes as a challenge to safety offshore and found that there were insufficient systems to deal with this risk. One of HSE's recommendations from KP4 was to use audits to identify and manage creeping change.

Creeping change is the accumulation of small changes that are gradual in nature, unseen and not planned, but can add up to a significant change. They may be difficult to detect and monitor using conventional hazard identification (HAZID) studies and risk assessments.

Experience from KP4 and learning from major accidents involving creeping changes have suggested a multi-disciplinary approach is required; consequently, the creeping change hazard identification (CCHAZID) methodology set out in this technical publication covers both engineering and human/organisational issues. As well as providing the CCHAZID methodology and guidance on its application, this technical publication describes three pilot CCHAZID studies carried out at diverse energy industry facilities to further develop the CCHAZID methodology.

The CCHAZID methodology uses a workshop approach like that used in a conventional HAZID study in that keywords are used, with a team of people from a wide range of appropriate disciplines (including operations and maintenance personnel) to trigger discussions and brainstorm any potential issues. The team discusses the issues and identifies actions to improve risk control; these are addressed once the CCHAZID workshop has finished. However, the CCHAZID methodology is designed to be a screening tool, and as such a CCHAZID study is faster paced and less detailed than a conventional HAZID study; this allows an entire facility/organisation to be reviewed in a relatively short study. The aim of the CCHAZID study is to identify weak or overlooked creeping changes.

The CCHAZID methodology could be applied to any ageing plant or to plant with many or compound changes. Whilst it was piloted in and based on knowledge from high hazard industries it could be applied wherever there is a reliance on ageing equipment. The CCHAZID methodology is not solely for safety risks; it is also applicable to environmental and business risks.

The CCHAZID methodology should form part of the suite of safety studies used to regularly review plant. The CCHAZID methodology was developed to be a formal safety study conducted in a similar manner to a conventional HAZID; however, its keywords could be used as a checklist during reviews or in more informal discussions. It is not intended that a CCHAZID study replaces a conventional HAZID study; they are complementary techniques. Moreover, the CCHAZID methodology is complementary to OGUK *Cumulative risk guidelines*, in that it allows deviations to be identified.

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1 INTRODUCTION, SCOPE AND APPLICATION

1.1 INTRODUCTION

1.1.1 Creeping changes

Creeping changes are a safety, environmental and business risk that have only relatively recently been highlighted as a significant issue. HSE *Key Programme 4: Ageing and life extension programme – A report by the Energy Division of HSE's Hazardous Installations Directorate* ('KP4 report') covering the ALE challenges facing hydrocarbon exploration and production installations on the UKCS, identified creeping changes as a challenge to safety offshore and found that there were insufficient systems to deal with this risk. One of HSE's recommendations from KP4 was to use audits to identify and manage creeping change.

Creeping change is the accumulation of small changes that are gradual in nature, unseen and not planned, but can add up to a significant change. They may be difficult to detect and monitor using conventional HAZID studies and risk assessments. For example, the increase in the number of fuel leaks on the Nimrod aircraft that exploded over Afghanistan was a creeping change that was not noticed (see C.2).

While the effects of creeping changes are relatively uncommon, they are rarely trivial and have the potential to be devastating: 1.1.2 refers to the role of creeping changes in some major accidents. As well as major accidents, creeping changes can cause major equipment failure (potentially having both safety and production implications). It is widely recognised that controlling safety by effective asset management also leads to reducing failures and downtime, and so is key to maintaining or increasing production efficiency. Creeping changes will become ever more prevalent if not checked and addressed as industrial assets age. If equipment is failing regularly then it will not be available for production and may increase safety risks.

Companies should have a robust corporate memory or knowledge management system to ensure that past knowledge is not forgotten; in particular for the workforce changes, as this may be key when identifying and managing creeping changes.

1.1.2 Occurrence of creeping changes in major accidents

The Nimrod and Texas City major accidents both had creeping changes identified as a contributory factor (see Annex C); these show that creeping changes can occur in many different forms and issues often occur when these changes interact and/or are cumulative. Creeping changes are relevant across a wide range of disciplines including (but not limited to) process safety, mechanical engineering, human factors, and electrical, control and instrumentation (EC&I). Some examples of types of creeping change are:

– ageing (including degradation and obsolescence);
– process changes;
– equipment/infrastructure changes;
– management/ownership changes;
– workforce change/loss of skills;

– where there are many or cumulative operational risk assessments (ORAs) or management of changes (MoCs), especially where their interaction is unclear, and
– culture changes.

For further information on creeping change, see Goff (2015).

1.1.3 Development of CCHAZID methodology

Given the increased significance of creeping change, as indicated by HSE *KP4 report* (see 1.1.1) and its occurrence in major accidents (see 1.1.2), the EI commissioned HSL to develop a CCHAZID methodology. The aims of this work were to develop a methodology to identify creeping changes, including a set of keywords to be used, to trial the methodology, and to provide guidance on its application.

The CCHAZID methodology was trialled with Centrica at the following diverse energy industry facilities:

– a gas-fired power generation station;
– an onshore gas import terminal, and
– an offshore gas storage facility.

The facilities varied in their functions and complexity; one recently had its hazard and operability (HAZOP) study updated.

1.2 SCOPE

This technical publication provides a methodology to identify creeping changes, including a set of keywords. The CCHAZID methodology covers both engineering (including process safety; mechanical engineering, and electrical, control and instrumentation (EC&I)) and human/organisational changes. This technical publication also provides guidance on application of the CCHAZID methodology comprising the required participants, timescales and documentation, and contents of the outputs.

Also provided are the findings of trials of the CCHAZID methodology, which were used to further develop the CCHAZID methodology. These indicate the thought processes and outputs of the three pilot studies.

1.3 APPLICATION

The CCHAZID methodology uses a workshop approach like that used in a conventional HAZID study in that keywords are used, with a team of people from a wide range of appropriate disciplines (including operations and maintenance personnel) to trigger discussions and brainstorm any potential issues. The team discusses the issues and identifies actions to improve risk control; these are addressed once the CCHAZID workshop has finished. However, the CCHAZID methodology is designed to be a screening tool, and as such a CCHAZID study is faster paced and less detailed than a conventional HAZID study; this is to allow an entire facility/organisation to be reviewed in a relatively short study. The aim of the CCHAZID study

is to identify weak or overlooked creeping changes. Moreover, its keywords could be used as a checklist during reviews or in more informal discussions.

Atypical events can be classified for both awareness and knowledge using the classification system promulgated by Donald Rumsfeld (former United States Secretary of Defense): 'known known'; 'known unknown' (i.e. acknowledged); 'unknown known', and 'unknown unknown' (see Paltrinieri (2012)). A CCHAZID study aims to identify the unknown knowns, i.e. the creeping changes that have been overlooked or missed but which the organisation should be aware of; this then allows them to be managed correctly and safely. A CCHAZID study could also identify the unknown unknowns, and at that point they will become known unknowns, allowing the organisation to put a study in place to gain further knowledge of that risk.

Based on the pilot studies, one day was found to be a suitable length of time to spend on a CCHAZID study. This could be extended if necessary due to the nature of the target being studied, or a series of one-day workshops could be held. By comparison, to update a HAZOP study would typically take several days or weeks depending on the complexity of the facility.

The CCHAZID methodology is applicable to any ageing plant or to plant with many or compound changes. Whilst it was piloted in and based on knowledge from high hazard industries it could be applied anywhere where there is a reliance on ageing equipment.

During one of the pilot studies, the CCHAZID methodology was applied to a facility that had recently had its HAZOP study updated. While that pilot study found fewer potential creeping change issues than the other pilot studies, it still found issues that related to changes recently made to solve other problems (as per *The law of unintended consequences*[1]). Therefore, the CCHAZID methodology is complementary to techniques such as HAZID and HAZOP, and should form part of the suite of safety studies used as part of the regular review of plant. It is not intended that the CCHAZID methodology replaces a conventional HAZID. The CCHAZID methodology is complementary to OGUK *Cumulative risk guidelines*, in that it allows deviations to be identified.

Feedback from one of the pilot studies was that the company intended to use the outputs of the CCHAZID study as part of their upcoming process hazards review. A CCHAZID study could be triggered outside of regular reviews if many or compound changes have been noted, if problems are developing or as the result of findings from an incident investigation.

1 http://www.econlib.org/library/Enc/UnintendedConsequences.html