

Development of a Human Factors Guideline for the Usage of Abbreviations in Nuclear Power Plants

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1. Introduction

Human errors resulting from human factors deficiencies can be a significant contributing factor to incidents and accidents. And also, it is well known that Human Engineering Discrepancies (HEDs) can affect a system's performance and the reliability of NPPs. In order to resolve the problem from HEDs, the human factors of operating NPPs have been reviewed as a part of Periodic Safety Reviews (PSRs).

According to the safety enhancement issues from the result of previous PSRs, the consistency of terms among the Main Control Room (MCR), the Remote Shutdown Panel (RSP), and the local control station is not well maintained [1][2]. In this research, a practical human factors guideline for the use of terms is developed in consideration of the practicality and applicability.

2. Human Factors Issues of the Usage of Abbreviations

Major human factors problems from the usage of terms can be classified as 1) using a full name at the same time as an abbreviation, 2) using abbreviations together with an arbitrary code, 3) using punctuations and 4) using the unstandardized abbreviations. The examples are as follows :

Table 1. The list of inadequate usages of abbreviations

Type	Example
1	TRIP / TRP ; SPRAY / SPRY ; OPEN / OPN
2	TEMP / TEMP. ; A,B / "A", "B"
3	SMM ; S.M.M.
4	AFWP / AFW PP ; BKR / BRKR ; CH / CHN

3. General Types of abbreviations

An abbreviation is a shorten form of a word or phrase for brevity. Usually, it consists of a letter or a group of letters taken from the word or phrase. Apart from the common form of shortening one word, there are other types of abbreviations. These include acronyms and initialisms (include three-letter acronyms), apocopes, clippings, elisions, syncopes, syllabic abbreviations, and portmanteau[3]. The examples are listed in Table 2.

Table 2. The example of general types of abbreviations

No.	Type	Example
1	Substitution or Alteration	oz(ounce), Xmas(Christmas)
2	Plural abbr.	mss(manuscripts), pp(pages)
3	Acronym	NATO(North Atlantic Treaty Organization)
4	Initialism	ATM(Automated-Teller Machine)
5	Contraction	amt.(amount), Mr.(mister)
6	Apheresis	phone(telephone)
7	Aphesis	cause(because), cept(except)
8	Clipping	deli(delicatessen)
9	Portmanteau	aerobatics(aerial and acrobatics)
10	Syllabic abbr.	interpol(international police)

4. General Guideline for the Usage of Abbreviations

When an abbreviation is necessary due to space constraints, the words chosen for abbreviations should be commonly known in their abbreviated form, and those abbreviated words can be unambiguously interpreted.

The U.S. Nuclear Regulator Commission (USNRC) introduced a general guideline of abbreviations. And it is recommended that a truncation rule is the best method, except when word endings convey important information [4]. The following is a summary of the contents of section 1 and 11 related to the use of terms, abbreviations, and symbols :

1.3 Display elements

- Avoiding abbreviations : abbreviations should be avoided (except when terms are commonly referred to by their initialisms, e.g., SPDS).
- Abbreviation rule : when defining abbreviations that are not common to the user population, a simple rule should be used that users understand and recognize.
- Distinctive abbreviations : abbreviations should be distinctive so that abbreviations for different words are distinguishable.
- Punctuation of abbreviations : abbreviations and acronyms should not include punctuation.
- Easily remembered arbitrary codes : when arbitrary codes must be remembered by the user, characters should be grouped in blocks of three to five characters, separated by a minimum of one blank space or other separating character such as a hyphen or slash.

- Avoid O and I in arbitrary codes : the use of the letters O and I in a non-meaningful code should be avoided since they are easily confused with the numbers 0 (zero) and 1 (one), respectively.
- Combining letters and numbers in arbitrary codes : when codes combine both letters and numbers, letters should be grouped together and numbers grouped together rather than interspersing letters with numbers.

11.3 Labeling and Demarcations

- Commonly used terms and symbols : terms, abbreviations and symbols used on panel labels should have commonly accepted meaning for all intended users.
- Distinguishability : symbols should be unique and distinguishable from each other
- Consistency : labels should be consistent within and across panels in their use of words, acronyms, abbreviations, and part/system numbers.
- Administrative control : a list of standard names, acronyms, abbreviations, and part/system numbers should be in place and administratively controlled.
- Label similarity : words and abbreviations of similar appearance should be avoided where an error in interpretations could result.

5. Practical Human Factors Guideline for the Usage of Abbreviations

The following rules were summarized to ensure the practicality and applicability in the usage of terms by plant personnel in NPPs. The rules can classify into two classes.

1. The fundamental principle of abbreviation usage

- The rule for avoiding abbreviations: Abbreviations should be avoided. If a use of abbreviations is necessary due to space constraints, the meanings should be announced officially so that operators and maintenance personnel can decode them easily.
- The rule for maintaining consistency: To maintain consistency, the words chosen for an abbreviation should be kept throughout alarm windows, labels on the MCR panels, and procedures. Standardized abbreviations must be used at all the locations although there can be space allowance at some locations.
- The rule for keeping the custom of each NPP: Customary abbreviations should be applied prior to an application of new abbreviations in order to reduce additional load of learning and training.
- The rule for making a new abbreviation: When a new word is to be abbreviated, the rules for making abbreviations listed as below should be kept.

2. The rule for making abbreviations

- Abbreviations by truncation rule should be used, except when word endings have an important

information

(ex. Pressure(PRESS), outlet(OUTL)).

- Abbreviations and Acronyms should not include punctuations
- Arbitrary codes should be remembered easily.
- Abbreviations related to the positions of a controller or the states of an indicator should be consistent with the positions or the states.
- When terms represent system states and the number of letters is less than five, full names should be used (ex. TRIP, STOP, START, OPEN, CLOSE, FAIL, ALARM, and etc.)
- When terms express systems, acronyms should be used (ex. Diesel Generator(DG), Reactor Coolant System(RCS)).
- A preposition should be used in full words (ex. BY, TO, IN, FOR, and etc.)
- Customary abbreviations specific to a NPP should be used with a priority (ex. Turbine(TBN), Auxiliary Feedwater Pump(AFWP))
- When word endings have an important information, main consonants should be declared (ex. sampling(SAMPLG), condenser(CONDSR), and etc.)
- A suffix should be used as a shorten form (ex. ed(D), less(LS), ness(NS), able(BL), ance(NC), and etc.)
- A conjunction should have a consistent meaning (ex. And(&), or(/))
- It should be avoided that characters and numbers are easily confused each other.

6. Conclusion

A shortened form of a word or phrase for brevity can induce human errors in an interpretation and communication. In this study, a human factors guideline for the usage of abbreviations which ensures a practicality and an applicability was developed on the basis of NUREG-0700(Rev.2) [4]. This guideline can be used as a protocol for good human factors design in Korean NPPs.

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