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ACKNOWLEDGMENT

The American Institute of Chemical Engineers wishes to acknowledge the cooperation of The Dow Chemical Company in releasing their 7th edition of the Fire and Explosion Index Hazard Classification Guide for publication. Special thanks to N. E. Scheffler, W. R. Heitzig, J. F. Murphy, S. M. Hartnagle, N. H. Humphrey, B. H. Scortichini and T. O. Gibson of The Dow Chemical Company, whose careful evaluation and review of this material provided some important innovations to make the Guide more useful to the chemical industry.

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LC 80-29237
ISBN 0-8169-0623-8
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PREFACE

Since the first edition of this guide was issued in 1964, the Fire & Explosion Index (F&EI) has evolved through the past 29 years into a comprehensive index that gives a relative value to the risk of individual process unit losses due to potential fires and explosions. The primary purpose of the F&EI is to serve as a guide to the selection of fire protection methods. Its broader purpose was to have a method for the relative ranking of individual process units focused on key items of equipment.

This index has been widely used in Dow and outside of Dow. It is the leading hazard index recognized by the chemical industry. The present F&EI provides key information to help evaluate the overall risk from fire and explosion. The F&EI can be used in conjunction with the Chemical Exposure Index Guide, 2nd ed. and other process information to form a Risk Analysis Package to better understand the potential risks to a manufacturing unit. This package is an important part of the Consolidated Audit process.

The F&EI is one of the tools used for evaluation of realistic fire, explosion and reactivity potential of process equipment and its contents. The F&EI is also tied into the Distribution Ranking Index (DRI).

The seventh edition is primarily an update of the sixth edition, and there are no major conceptual changes. Improvements have been made in wording and updating has been done to remain consistent with Codes and Loss Prevention Principles. A major update has been made in Appendix A, Material Factors, which gives the latest NFPA ratings, flash points, boiling points and, most importantly, Material Factors.

Improvements in the seventh edition include:

- Correction of the errata which had been noted in the sixth edition.
- Incorporation of a table of F&EI versus Degree of Hazard.
- Major updating of Appendix A to give most recent NFPA ratings and Material Factors which agree with Table 1.
- Revision of F&EI forms that have been streamlined and put into computerized spreadsheet formats.
- Updating of the Determination of Material Factor and Toxic Materials NFPA ratings in accordance with the latest NFPA 704 definitions.
- Addition of equations for the curves in the figures to aid in the calculation of factors and allow for computer determination of values.
- Inclusion of SI (International System of Units) units in addition to US/British units.
- Improvement and addition of examples.
- Some revamping in the Loss Control Credit Factors area with elimination of buried tank credit and reference to halons and new credit for process hazard reviews.
- Reorganization of Process Unit Risk Analysis Summary section.
- Updating discussion regarding Maximum Probable Property Damage and plant layout considerations.
- Minor revisions to the Loss Prevention Checklist.

The Fire & Explosion Index Hazard Classification Guide has been made available as an edited version to all interested parties through the American Institute of Chemical Engineers (AIChE), 345 East 47th Street, New York, NY 10017 [Phone (212) 705-7657]. Various countries have referenced the F&EI guide in their respective governmental regulations.
The Fire and Explosion Risk Analysis System is a step-by-step objective evaluation of the realistic fire, explosion and reactivity potential of process equipment and its contents. The quantitative measurements used in the analysis are based on historic loss data, the energy potential of the material under study, and the extent to which loss prevention practices are currently applied.

The purpose of the F&EI system is to:
1. QUANTIFY the expected damage of potential fire, explosion and reactivity incidents in realistic terms.
2. IDENTIFY equipment that would be likely to contribute to the creation or escalation of an incident.
3. COMMUNICATE the F&EI risk potential to management.

Beneath all the numbers, graphs and figures, however, lies the most important goal of the F&EI System — to make the engineer aware of the loss potential of each process area and to help the engineer identify ways to lessen the severity and resultant dollar loss of potential incidents in an efficient and cost effective manner.

The F&EI is used in the Dow Risk Review Process. Determination of the F&EI must be done in conducting a Process Hazard Analysis or Level I Risk Review.

Insurance company assessments of potential exposures are typically based on the worst imaginable incident. They might anticipate, for example, that the complete contents of a reactor dump could vaporize instantaneously and ignite; and their insurance loss estimates, which are determined in part from this kind of analysis, can be extremely large. From a realistic point of view, this kind of situation is rare.

The Dow F&EI system attempts to determine the realistic maximum loss that can occur to a process plant (or process unit) or related facility — a loss that could actually be experienced under the most adverse operating conditions. The calculation is based on quantifiable data. Finite spill rates, process temperature in relation to material flash points and boiling points and reactivity are just a few of the many contributors to a probable incident.

Although the F&EI system is primarily designed for any operation in which a flammable, combustible or reactive material is stored, handled or processed, it may also be used in analyzing the loss potential of sewage treating facilities, distribution systems, pipelines, rectifiers, transformers, boilers, thermal oxidizers and certain elements of power plants. The system can also be used for risk evaluations of small processes with modest inventories of potentially hazardous materials; its application to pilot plants is strongly recommended. The system can be applied if handling a minimum of approximately 1,000 lb (454 kg) of a flammable or reactive material.

A word of caution is in order for those planning to use the F&EI system for the risk evaluation of facilities. Common sense and good judgment must be used during the actual calculation and in the interpretation of its results. Process hazards that contribute to the magnitude and probability of losses have been quantified as “penalties” to provide factors for computation. Not every penalty may be applicable to a specific situation and perhaps some may have to be adjusted.
PROCEDURE FOR RISK ANALYSIS CALCULATIONS

To develop an F&EI and Risk Analysis Summary, the following are needed:

a. An accurate plot plan of the plant (manufacturing unit)
b. A process flow sheet
c. A Fire & Explosion Index Hazard Classification Guide, Seventh Edition
d. An Fire & Explosion Index Form (page 5 – F&EI, Seventh Edition)
e. A Loss Control Credit Factors Form (page 6 – F&EI, Seventh Edition)
f. A Process Unit Analysis Summary Form (page 6 – F&EI, Seventh Edition)
g. A Manufacturing Unit Risk Analysis Summary Form (page 7 – F&EI, Seventh Edition)
h. Replacement cost data for the installed process equipment under study.

The procedure to be followed is listed below. Figure 1, page 4, presents a flowchart outlining the procedure for risk analysis calculations.

1. Selection should be made on the plot plan of the Pertinent Process Units that are considered of key importance to the process and that would have the greatest impact on the magnitude of a potential fire or explosion.

2. Determination is to be made of the Material Factor (MF) for each Process Unit. The MF for a particular material in the Process Unit is to be obtained from Table 1, page 13 or Appendices A or B, pages 60 to 73.

3. Calculation is to be completed for the General Process Hazards Factor with application of the appropriate penalties according to the F&EI Form, page 5.

4. Calculation is to be completed for the Special Process Hazards Factor with application of the appropriate penalties according to the F&EI Form, page 5.

5. Determination of the Process Unit Hazards Factor is to be done by calculating the product of the General and Special Process Hazards Factors.

6. Determination of the F&EI is to be done by calculating the product of the Process Unit Hazards Factor and the Material Factor.

7. Determination of the Area of Exposure surrounding the Process Unit being evaluated is to be performed based on Radius of Exposure from Figure 7, page 48, and pages 47 to 50.

8. Determination of the replacement value of all equipment within the Area of Exposure and the inventory is to be done.

9. Determination of the Damage Factor, which represents the degree of loss exposure, is to be done using Figure 8, page 53, based on the MF and the Process Unit Hazards Factor (F3).

10. Determination of the Base Maximum Probable Property Damage (Base MPPD) is to be made by multiplying the Value of the Area of Exposure by the Damage Factor.

11. Application of the Loss Control Credit Factor to the Base MPPD allows for the determination of the Actual MPPD.

12. Determination of the Maximum Probable Days Outage (MPDO) is performed by using Figure 9, page 55, knowing the Actual MPPD.

13. Determination of the Business Interruption (BI) is done by using the equation given on page 56 where the MPDO is multiplied by the Value of Production for the Month (VPM) and by 0.70/30.

Each of the steps given above is outlined and explained in the following pages of this guide. Appendix C, Basic Preventive and Protective Features, and Appendix D, Loss Prevention Checklist, are also provided for use in assessing the important loss control areas in a plant or manufacturing unit.

When developing the F&EI, it is recommended that people with a working knowledge of the plant’s history/experiences be contacted to discuss probable incident scenarios to assure the most viable F&EIs are developed.