INSAG

INTERNATIONAL NUCLEAR SAFETY ADVISORY GROUP

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1991

INSAG TECHNICAL NOTE No.3

A REVIEW OF THE REPORT 'IAEA SAFETY TARGETS AND PROBABILISTIC RISK ASSESSMENT' PREPARED FOR GREENPEACE INTERNATIONAL

A report by the
International Nuclear Safety Advisory Group

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 1991

The International Nuclear Safety Advisory Group (INSAG) is an advisory group to the Director General of the International Atomic Energy Agency, whose main functions are:

(1) To provide a forum for the exchange of information on generic nuclear safety issues of international significance;
(2) To identify important current nuclear safety issues and to draw conclusions on the basis of the results of nuclear safety activities within the IAEA and of other information;
(3) To give advice on nuclear safety issues in which an exchange of information and/or additional efforts may be required;
(4) To formulate, where possible, commonly shared safety concepts.

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PREFACE

At the request of the Director General, INSAG reviewed the report 'IAEA Safety Targets and Probabilistic Risk Assessment' prepared for Greenpeace International by the Gesellschaft für Ökologische Forschung und Beratung mbH, Hannover, Germany. The conclusions of the report are reproduced here. At its meeting in June 1990, INSAG approved the following document and forwarded it to the Director General. The review is issued as the third in the series of INSAG Technical Notes.

CONCLUSIONS OF

'IAEA SAFETY TARGETS AND PROBABILISTIC RISK ASSESSMENT'

A report prepared for
Greenpeace International[1]

"Probabilistic risk assessment (PRA) (Levels I and II) is not an adequate tool to determine the frequency of severe core damage, or the probability of early containment failure, or the probability of other accident categories.

"Even the most 'simple' aspect of PRAs (modelling accident sequences taking into account solely internal initiating events, component failures and human errors of omission) is beset with uncertainties which yield very large error margins. The error margins are still larger when containment behaviour is considered. In many cases, this is compounded by systematic underestimation of accident probabilities.

"Furthermore, many important contributors are excluded from PRAs: complicated forms of human error; many forms of unexpected plant defects; unforeseen physical processes; sabotage; and acts of war. Many PRAs even completely exclude external accident initiating events.

"Thus, the result of a PRA is not an estimate of 'severe core damage frequency'. It is, rather, a form of risk indicator with a severely limited scope, useful only for limited purposes. The 'true' severe core damage frequency in fact would be this indicator times an unknown factor which is larger than 1 (taking into account the inaccuracies and optimistic assumptions in those areas which are included in PRAs, as demonstrated in this study); plus another unknown factor which is larger than zero (taking into account the issues which are omitted in PRAs); or:

$$\text{SCDF} = (\text{PRA result}) \times (\text{Unknown factor No. 1}) + (\text{Unknown factor No. 2})$$

"A similar equation holds for estimates of early containment failure.

"The practice of referring to PRA results as accident frequencies is thus misleading and should be abandoned. It constitutes a perversion of a methodology which has without doubt — if its limitations are kept in mind — a number of useful applications.

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[1] HIRSCH, H., EINFALT, T., SCHUMACHER, O., THOMPSON, G., IAEA Safety Targets and Probabilistic Risk Assessment: State of the Art, Merits and Shortcomings of Probabilistic Risk Assessment, Gesellschaft für ökologische Forschung und Beratung mbH, Hannover (1989). For further information, please consult: Greenpeace International, Keizersgracht 176, 1016 DW Amsterdam, The Netherlands. Telefax (31) 20 5236500.

"Therefore, the IAEA safety targets are useless for policy purposes. It cannot be reliably determined whether a particular plant meets them (although findings from current PRAs, taken at face value, suggest that most plants currently do not). Any claim that PRAs show that probabilistic safety targets are more or less met is wishful thinking and might be dangerously misleading.

A REVIEW OF THE REPORT 'IAEA SAFETY TARGETS AND PROBABILISTIC RISK ASSESSMENT' PREPARED FOR GREENPEACE INTERNATIONAL

The conclusions of the report reflect familiarity with the literature of probabilistic safety assessment (PSA). The authors repeat many of the questions that have often been raised about the accuracy of PSA.

However, INSAG does not find in this report any such questions that are new and original. In particular, they are among the ones explored at length in the United States of America in the current draft of the Nuclear Regulatory Commission document NUREG-1150 and in the ongoing review of that draft by a committee which Dr Kouts [the chairman of the International Nuclear Safety Advisory Group (INSAG)] is chairing for the Nuclear Regulatory Commission and on which Professor Birkhofer [a member of INSAG] also serves. INSAG agrees with the authors of the report 'IAEA Safety Targets and Probabilistic Risk Assessment' prepared for Greenpeace International on the validity of the questions and their importance to the results of PSA (though not necessarily with their inferences). It is in other respects that INSAG finds itself differing most from the report.

First, it is INSAG's view that the Greenpeace report is much too negative in tone when it discusses the areas in which information is not as full as would be desirable. These areas are well known to those who use PSA. The authors of the Greenpeace report have not discovered them or revealed them; they have only repeated, without balance and with what INSAG perceives to be coloured words, material drawn from some of the many scholarly works that have been written by serious researchers on the logical foundations of PSA. Seldom if ever do these researchers who study the basis of PSA condemn the science or its practice. They usually state their points as precautions that should be observed in its application, or as material deserving more attention.

Reviews in the USA have confirmed that the incompleteness of information in some areas has only slight effect, but in other areas it contributes to large uncertainty margins attached to the final results of PSAs. That is, the risk may be much smaller than the calculated means, or it may be greater. In almost every case the range extends much farther towards lower risk, because forming the mean or the average gives more weight to the high values. In any case, these uncertainty margins are as important as the mean values of risk, and they strongly affect the legitimacy of uses of the PSA.

Second, the Greenpeace report refers to the safety targets as having been adopted by the IAEA. They are really INSAG's targets and have not been specifically adopted or endorsed by the IAEA. The authors of the Greenpeace report have not understood INSAG's intentions in stating a safety target for commercial nuclear

plants throughout the world[2]. INSAG is fully aware that PSA is not yet developed to the point that it can be used as a definitive means of determining whether the numerical target has been met. The range of uncertainty is still too great for use of PSA in 'bottom line' evaluation.

Nevertheless, INSAG believes that the concept of the probability of a severe accident is a useful one, and it would be useful in application to the safety of any energy technology. PSA is one of the tools that can be applied to estimating this probability. Other insights can be gained using other tools: historical records of accidents and accident precursors at plants having a substantial similarity; comparisons with other plants for which accuracy of estimates may be better; specific conditions at a plant, such as an unusually good or bad operating regime; deterministic safety analysis; and even comparisons that can be made with other than nuclear technologies. Each method of assessment has its problems, and all possible methods must be used for the most satisfactory conclusion.

In the last analysis, it is only the historical record over a long period of operation of nuclear plants throughout the world that will define the true post hoc value of accident probabilities, and it is the accumulation of this record that INSAG would ultimately rely on as the real measure of having met the safety target.

Third, INSAG believes that the Greenpeace report fails to note the many valuable ways in which PSA is used in practice. PSA conveys many insights on safety that carry high potential benefit. Some are:

— The accident sequences contributing most to risk can be identified and improvements to design and operating practices can be effected.
— The value of proposed regulatory measures can be assessed on a basis of comparison of risk with and without the measures.
— Areas can be identified in which safety research could be beneficial.

These applications of PSA are possible because the comparison of two PSAs that differ in only one or a few details is a much more accurate indicator than either PSA alone.

In the field of nuclear safety, probabilistic risk assessment has graduated to a state of widespread use, with confident acceptance of its benefits and its limitations. The points raised by the Greenpeace report were taken up, debated and resolved to the satisfaction of safety experts quite a few years ago.

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[2] See INTERNATIONAL NUCLEAR SAFETY ADVISORY GROUP, Basic Safety Principles for Nuclear Power Plants, Safety Series No. 75-INSAG-3, IAEA, Vienna (1988), para. 25.

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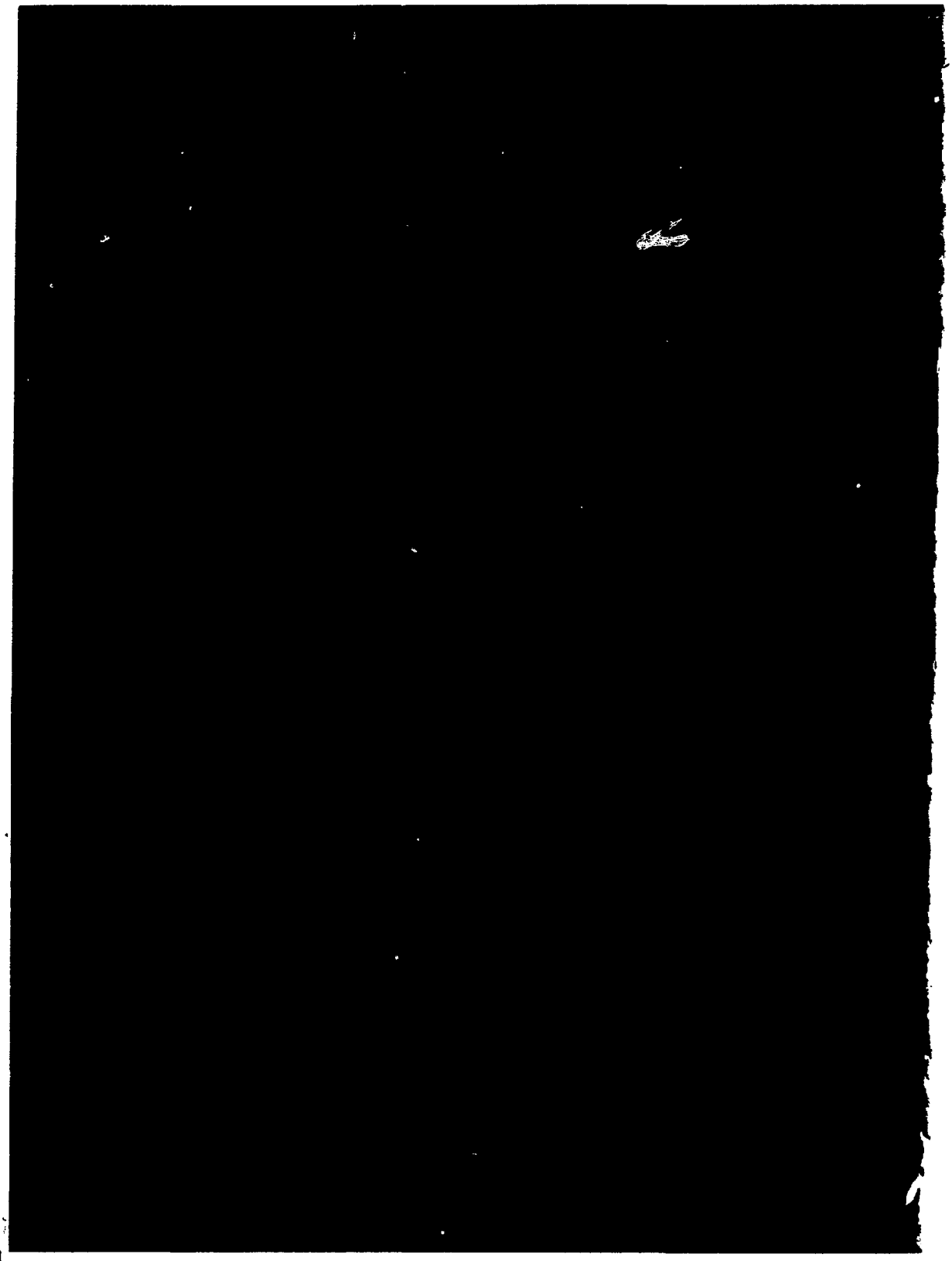

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