

Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium, and High-Level Radioactive Wastes in Flasks on Board Ships (INF Code)

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INTRODUCTION

The INF Code was adopted by the 18th Assembly of the International Maritime Organization (IMO) by Resolution A.748(18) (IMO, November 1993) as a voluntary Code of Practice for application by IMO Member States. This paper describes the work leading to the adoption of the INF Code and its subsequent application and further development among the IMO and International Atomic Energy Agency (IAEA) Member States.

SOLAS DANGEROUS GOODS REGULATIONS

The carriage by sea of all dangerous goods is regulated by Chapter VII of the Convention on the Safety of Life at Sea (SOLAS) 1974, as amended (IMO, 1992), which refers to, and is supplemented by, the International Maritime Dangerous Goods (IMDG) Code. Special requirements, such as for fire protection equipment for the carriage of dangerous goods by sea, are given in the other relevant chapters, e.g., in Chapter II-2 of SOLAS for fire protection. Only in the case of dangerous goods of Class 7, Radioactive Material, no special requirements have been included in the SOLAS Convention to date. It is important to note this point, as it was the perceived lack of special requirements applying to Class 7 cargoes that gave initial impetus to the development of the INF Code. During the subsequent development of special requirements for Class 7, the preferred approach was, at least initially, to include such requirements in a recommended Code of Practice, rather than by amending SOLAS.

The lack of special requirements in SOLAS for the carriage of radioactive materials and the anticipated more frequent/larger volumes of irradiated nuclear fuel expected to be transported by sea in the future were the principal reasons why Italy raised the question of the safe carriage of INF by sea at the fifty-second session of the Maritime Safety Committee (MSC) of IMO in 1985. Their concern was to ensure adequate fire protection of the cargo spaces used for the carriage of INF and that adequate damage stability of the ships carrying INF was provided for by appropriate IMO Regulation, particularly for the case of non-purpose-built ships. These ships could, until the adoption and implementation of the INF Code, be freely used to carry virtually

unlimited quantities of radioactive material, subject only to the provisions of SOLAS Chapter VII, the IMDG Code, Class 7, and the IAEA Regulations for the Safe Transport of Radioactive Material.

EARLY DEVELOPMENT OF THE INF CODE

As the matters raised by Italy concerned a number of different subsidiary bodies of the MSC, they were initially considered in a series of sessions by the Sub-Committees on Stability and Load Lines and Fishing Vessel Safety (SLF) and on Fire Protection (FP). Later the MSC widened the scope of its considerations to include both purpose-built and non-purpose-built ships and to cover also, e.g., hold cooling, ventilation and radiation protection equipment. The Sub-Committee on Ship Design and Equipment (DE) was requested to oversee and develop what was to become the INF Code. The Sub-Committee on the Carriage of Dangerous Goods (CDG) and its Working Group on Class 7 were first consulted on the development at the fortieth meeting of the CDG Sub-Committee in 1988, when the Working Group was asked to provide a definition of the maximum quantities of INF material to be permitted for carriage on non-purpose-built ships.

DIFFERING VIEWS ON THE NEED FOR THE INF CODE

The Working Group on Class 7 expressed the opinion that additional fire protection measures were unnecessary on ships used for the carriage of INF, in view of the stringent protection provided by the package design and test criteria of the IAEA Transport Regulations, implemented at sea by the IMDG Code. However, the Sub-Committee did not accept this opinion and proceeded to draft requirements for three classes of ships, according to the aggregate quantity of INF to be carried, which were developed in 1990 by the forty-second meeting of the CDG Sub-Committee.

At this stage the IAEA became aware of the development of the INF Code. As the philosophy of IAEA has always been that safety in transport of radioactive materials should be provided principally by the design of the package, the Standing Advisory Group on the Safe Transport of Radioactive Material (SAGSTRAM), at its eighth session in December 1990, took the view that there was no need, on safety grounds, for specific ship design or fire protection requirements to be applied when transporting INF in larger quantities. The Director-General of IAEA wrote to the Secretary-General of IMO in May 1991 proposing that the risk associated with sea transport of INF be assessed by IAEA in close collaboration with IMO and that modification of IAEA Regulations should be considered, if it were to be found that such risk was indeed more severe aboard ship than on land.

Following an invitation of the Director-General of IAEA, the MSC agreed to establish a Joint IAEA/IMO Working Group on the Safe Carriage of INF by sea.

JOINT IAEA/IMO/UNEP WORKING GROUP

The Joint Working Group, which was extended to become the Joint IAEA/IMO/UNEP Working Group on request of the United Nations Environment Programme (UNEP) to participate, met twice, namely December 7-11, 1992, in London at IMO Headquarters and April 26-30, 1993, in Vienna at IAEA Headquarters.

The terms of reference for the Joint Working Group, as agreed between IAEA and IMO, were (IMO, September 1992, Annex 1):

- (a) To study the adequacy of existing provisions for the safe transport of irradiated nuclear fuel by sea. To take into account the impact of marine casualties, such as fire, explosion, or breach of the hull, on packaging integrity. To assess the probability of such casualties occurring;
- (b) Within the purview of the tasks specified under (a) to make recommendations for any action deemed necessary; and
- (c) To consider whether the marine transport of other radioactive material should also be studied.

The two sessions of the Group were well attended by 27 and 28 IAEA/IMO Member Government representatives, respectively, and Observers from 4 intergovernmental and 4 nongovernmental international organizations, including environmental groups. One of the main conclusions of the first Joint Working Group meeting was to include nuclear materials of similar potential hazard to INF in the Code, thus expanding it to cover also plutonium (Pu) and high-level radioactive wastes (HLW).

The second Joint Working Group meeting reached the following conclusions (IMO, April 1993):

1. The Joint Working Group agreed, by consensus, on the draft Code for the Safe Carriage of Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes in Flasks on Board Ships. The Joint Working Group recommended that the MSC and MEPC approve the Code with a view to its submission to the eighteenth session of the IMO Assembly for adoption (October/November 1993).
2. The Member States of the Joint Working Group agreed that:
 1. There was no information or data in the papers submitted to the first and second sessions that would cast doubt on the adequacy of the IAEA Regulations;
 2. The papers supported the existing experience and knowledge of Member States and indicated low levels of radiological risk and environmental consequences from the marine transport of radioactive material; and
 3. Any further consideration of packaging standards should be addressed through the established revision process of the IAEA.
3. The Joint Working Group identified several matters that require further consideration by IMO and IAEA and are complementary to the INF Code, such as emergency response plans, notification of coastal States about shipments of nuclear materials, positive tracking of vessels transporting INF 2 and INF 3 quantities, and the fitting of transport containers with a device to assist their location and recovery, should they be lost at sea, etc.

4. The Joint Working Group recommended that the need for international cooperation for the implementation of the INF Code and related matters be kept under review by IMO and IAEA.

The Joint Working Group considered a wide range of available published reports concerning the risks of sea transport of radioactive material and the consequences of postulated releases of such material into the marine environment. None of these reports showed any substantiated need, taking account of marine conditions, to amend the existing IAEA Regulations.

The Joint Working Group considered that it had completed its assigned tasks and recommended its dissolution, which was subsequently endorsed by its parent IAEA and IMO bodies.

At IMO the MSC (IMO, June 1993, paragraph 12.7) and the Marine Environment Protection Committee (MEPC) (IMO, July 1993, paragraphs 4.13 and 4.17) approved the draft INF Code and recommended its adoption as a Code of Safe Practice to the eighteenth Assembly of IMO.

During the consideration at the sixty-second meeting of the MSC and the thirty-fourth meeting of MEPC, respectively, 3 and 8 Member Governments reserved their position toward adoption of the INF Code, as drafted. However, the vast majority of Member States represented, 64 at MSC and 53 at MEPC, agreed that the draft Code was a significant first step toward ensuring the safe carriage of nuclear materials by sea and the protection of the marine environment, though it was considered to need improvement and augmentation in the future.

The INF Code was consequently adopted by resolution A.748(18) (IMO, November 1993) on November 4, 1993, by the eighteenth session of the IMO Assembly. It is of interest to note that during the considerations of the relevant Assembly Committee, the resolution was redrafted, which is quite unusual, to make it acceptable to the majority of IMO Members. The most significant amendments in the draft resolution, apart from referring to Chapter 17 of Agenda 21 of the United Nations Conference on Environment and Development (UNCED) in Rio (1992), were that the Assembly (IMO, November 1993, Part B):

"RECOGNIZING the need for further work to be carried out, with a view to augmenting or improving the INF Code,

REQUESTS the Maritime Safety Committee and the Marine Environment Protection Committee, in consultation with IAEA:

- (a) to keep the INF Code under regular review and to amend it, as necessary;
- (b) to consider, as a matter of high priority, relevant aspects of the transport of irradiated nuclear fuel and other nuclear material which are complementary to the INF Code, taking into account the recommendations of the Joint IAEA/IMO/UNEP Working Group and the objectives of paragraph 17.22 of Agenda 21 of UNCED;

- (c) to keep under review the need for international cooperation for the implementation of the INF Code and related matters; and
- (d) to report to the nineteenth session of the Assembly on the progress of work made in this field."

The Assembly, when adopting the INF Code, was attended by 131 Member and 2 Associate Member delegations of which only 7 Members reserved their position until the Code has been augmented and improved. Meanwhile the relevant IAEA bodies have also endorsed the adoption of the INF Code.

APPLICATION

The Code is a recommendatory instrument and applies to all new and existing ships, even those below 500 gross tons. It applies in addition to the applicable IAEA Transport Regulations and the requirements of Class 7 of the IMDG Code.

For the purposes of the INF Code, the following definitions apply (IMO, November 1993, Annex, paragraph 2):

1. Irradiated nuclear fuel means material containing uranium, thorium and/or plutonium isotopes that has been used to maintain a self-sustaining nuclear chain reaction.
2. Plutonium means the resultant mixture of isotopes of that material extracted from irradiated nuclear fuel from reprocessing.
3. High-level radioactive wastes means liquid wastes resulting from the operation of the first stage extraction system or the concentrated wastes from subsequent extraction stages, in a facility for reprocessing irradiated nuclear fuel, or solids into which such liquid wastes have been converted.

The INF Code follows a three-tier approach, whereby ships carrying materials covered by the INF Code have been assigned to three classes, depending on the total radioactive quantity that may be carried on board (IMO, November 1993, Annex, paragraph 3):

- Class INF 1 - Ships carrying such materials with an aggregate radioactivity less than 4 000 TBq.
- Class INF 2 - Ships carrying irradiated nuclear fuel or high-level radioactive wastes with an aggregate radioactivity less than 2×10^6 TBq and ships carrying Plutonium with an aggregate radioactivity less than 2×10^5 TBq.
- Class INF 3 - Ships carrying irradiated nuclear fuel or high-level radioactive wastes and ships carrying Plutonium with no restriction on the aggregate radioactivity of the materials.

All ships, regardless of size, carrying materials covered by the INF Code should comply with the requirements of SOLAS 1974, as amended, and additionally with the requirements as prescribed in Table 1 and paragraphs 7 to 25 of the INF Code, concerning damage stability, fire protection, temperature control of cargo spaces, structural considerations, cargo securing arrangements, electrical supplies, radiological protection equipment and management, training and shipboard emergency plans.

CARRIAGE OF INF ON PASSENGER SHIPS

The fact that the carriage of some INF is permitted on passenger ships (Class INF 1 and INF 2 only. INF 3 is not permitted on passenger ships) has been of concern to some of the IMO Member Governments, which accordingly reserved their position during the adoption. The reason for permitting these materials on passenger ships is that such ships are among the safest ships afloat and comply with most of the additional requirements of the INF Code, in particular with those for stability. It would have been preferable to use the term "ships complying with the provisions for passenger ships" in the INF Code. Attempts were made, during the Assembly session, to redraft the relevant footnote in table 1, but these were soon abandoned, in order not to prolong discussion.

It is not anticipated that these materials will be transported on ships operating as passenger ships, other than perhaps cargo ferries, which carry a limited number of passengers (i.e., lorry drivers). There are other IAEA Regulations in place, e.g., the Convention on the Physical Protection of Nuclear Material (IAEA, May 1980), that prohibit such transport in certain circumstances.

AUGMENTATION AND IMPROVEMENT

The IMO Assembly, having adopted the INF Code, concluded that it should be kept under review and be amended, as necessary. The Code, as it was originally conceived and later adopted, covers principally matters of ship's design, construction and equipment. In the latter stages of its development, particularly during the two sessions of the Joint IAEA/IMO/UNEP Working Group, some Member States of IMO and Observer Organizations sought to deal with other "complementary" issues within the Code, matters that it was not originally intended to cover, such as (IMO, May 1993, Annex 7):

1. Preparation of a "Voyage Plan" including, inter alia:
 1. Packaging specific information;
 2. Emergency response plan for packaging(s); and
 3. Emergency response plan for the ship;
2. Notification provided to coastal States with respect to INF, Pu and HLW shipments;
3. Routeing of ships carrying INF, Pu and HLW;

4. Positive tracking of INF 2 and INF 3 shipments;
5. Equipment of transport containers for INF 2 and INF 3 materials with devices assisting their location and recovery if lost at sea; and
6. Third-party liability issues.

As instructed by the eighteenth Assembly, IMO's MSC (IMO, June 1993, paragraph 12.9) and MEPC (IMO, July 1993, paragraph 4.17.4) and their subsidiary bodies concerned undertook work on matters complementary to the INF Code and reported progress to the nineteenth session of the IMO Assembly (November 13-24, 1995), which agreed to:

1. Endorse the Secretary-General's proposal for a Special Consultative Meeting (SCM), organized and convened in consultation with IAEA and UNEP as a matter of priority, to encourage a thorough examination of all aspects of the carriage by sea of materials falling under the purview of the INF Code; and
2. Invite Member Governments and international organizations concerned to participate in this meeting, which is tentatively scheduled for March 4-6, 1996.

The Assembly further approved an Assembly resolution on the review of the INF Code, requesting the relevant IMO bodies, in consultation with IAEA and UNEP, as appropriate, and taking into account the outcome of the Special Consultative Meeting, *inter alia*, to continue the review of the INF Code; to consider specific hazards in maritime transport and consequences of severe accident scenarios, structural requirements for securing, adequacy of the existing requirements for marking and labelling, route planning, notification to coastal States, restriction or exclusion of the ships from particularly sensitive sea areas, adequacy of existing emergency response arrangements, measures to locate sunken ships or flasks, availability of suitable salvage equipment and recovery expertise, ship tracking, accident notification; and to report to the twentieth session of the Assembly in 1997.

THE WAY FORWARD

Rather than developing new emergency response preparedness plans for maritime transport accidents with radioactive materials, one should look toward the IAEA and build upon the work that has been done for transport accidents in general. The Agency has agreed to review and, if necessary, revise the recommendations given in Safety Series No. 87, Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material (IAEA, 1988), as a matter of priority. IMO would naturally need to cooperate in such a revision process for emergency response at sea, which would also satisfy the corresponding request of the IMO Assembly, namely, for the MSC and MEPC to act "in consultation with IAEA."

Other outstanding matters that need to be considered to augment/improve the INF Code fall largely within the scope of existing IMO Committees and will continue to be dealt with by those Committees after the SCM. It will be important to ensure that these issues are dealt with on a common and rational technical basis with other classes

of dangerous goods (on a "level playing field") and that INF is not treated as a special case.

The IAEA have, with effect from September 1, 1994, initiated a Coordinated Research Programme to evaluate "Accident Severity at Sea during the Transport of Radioactive Material." The prime objective of the programme is to ensure the continuing validity of the principle of providing safety "designed in" to packages. Seven IAEA Member States are currently contributing to this programme, which embraces theoretical studies, practical studies (tests), and risk assessments. Other papers to be presented at PATRAM '95 will detail the interim results of these studies.

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