



Dangerous forces: the protection of nuclear power plants in armed conflict

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As the international armed conflict between Russia and Ukraine drags on, the international community continues to sound the alarm about the significant risks of a nuclear reactor accident as a result of protracted fighting around the Zaporizhzhia Nuclear Power Plant – the largest nuclear power plant in Europe and among the ten largest in the world.

In this post, ICRC Legal Advisers Abby Zeith and Eirini Giorgou take a closer look at the limits imposed by international humanitarian law (IHL) to protect works and installations containing dangerous forces – such as nuclear electrical generating stations – against the danger of hostilities, and what is at stake.

ICRC Humanitarian Law & Policy Blog · Dangerous forces: the protection of nuclear power plants in armed conflict

Because of the grave risks for civilians and the environment from the release of the dangerous forces they contain, international humanitarian law (IHL) affords special protection to nuclear electrical generating stations (more commonly referred to as nuclear power plants).

While the applicable IHL provisions establish a detailed system of protection, the gist of it is very simple: to avoid that nuclear power plants become battlegrounds or are incidentally damaged by the fighting. The law therefore imposes obligations on all parties to armed conflict to refrain from attacking nuclear power plants, and to avoid as much as possible any action that would expose them to attack, including locating military objectives at or in the vicinity of such facilities.

Why is there a need to protect nuclear power plants from the effects of hostilities?

The safe and secure operation of a nuclear power plant is complex. Several nuclear safety and security measures must be in place to prevent and manage the risks of nuclear accidents and other incidents compromising the plant's physical and functional integrity. Nuclear power plants contain radioactive material, which is extremely harmful to humans and to the environment it comes in contact with. Radioactive material may be released when various components of a nuclear power plant – such as reactors or tanks storing spent fuel – are destroyed or damaged, or their functioning is impaired.

The risk of radiation leak as a result of military activities in and around such facilities is very high, considering the likelihood of damage to a reactor or to other critical components enabling the safe and secure functioning of the facility. Such damage can be caused directly, for instance by a shell hitting one of such components; indirectly through interruptions in water or electricity flow caused by the fighting; or result from operational failure due to staff death, injury or other inability to ensure the safe and secure functioning of the plant (for instance frontlines or movement restrictions by the parties to the conflict preventing staff or system components to reach the plant, or human error by staff operating under increasing stress and strain).

The consequences would be devastating. Damage to a nuclear reactor could result in immediate exposure to lethal concentrations of gamma radiation and radioactive contamination by inhalation of airborne radioactive particles, with severe short- and long-term effects on human health and on the environment. An explosion of the reactor or spent fuel tanks would mean that radioactive particles from fissionable material and fission products are carried downwind, potentially over vast distances and in an unpredictable manner, depending on meteorological conditions. But even absent an explosion, leaked radioactive material, for instance as a result of damage to the plant's storage tanks or containment system, would seep into the soil and underground water, poisoning the flora and fauna in a large radius extending up to hundreds of kilometres around the damaged power plant.



The effects of radiation are impossible to control in time and space. In addition to radiation poisoning and other illnesses, some genetic mutations caused by ionizing radiation exposure have been proven to transcend generations. Due to its spread over large areas and large life span, radioactive material can have devastating effects on ecosystems, agriculture and food security, exposing large populations to short- and long-term risk of disease and death, as well as mass displacement. The remediation of the natural environment affected is time-consuming, and in some cases (such as contaminated water bodies) impossible. The impact on the food chain would be felt for years, if not decades.

In addition to containing dangerous forces, nuclear power plants mass-produce electricity, which is indispensable to the survival of the civilian population. Typically, a nuclear power plant will provide electricity for hundreds of thousands of households, while for the largest ones the figure can

amount to millions. Damage to or disruption of the functioning of the plant risks depriving large areas of electricity, with grave impact on other essential services and on the wellbeing of hundreds of thousands, if not millions, of civilians.

Are nuclear power plants protected during armed conflict?

The answer to this question is: yes, and strongly so. The most detailed provisions are found in the 1977 First Additional Protocol (AP I), but they are also protected under the 1977 Second Additional Protocol (AP II) and customary IHL applicable in international and non-international armed conflicts.

All States have a right to the peaceful use of nuclear energy, including for electricity production (*Articles IV and V of the Treaty on the Non-Proliferation of Nuclear Weapons*). Nuclear power plants are civilian objects, and as such are protected against direct attack and reprisals (*Art 48 API; CIHL Rule 7*). In case of doubt whether a nuclear power plant is being used to make an effective contribution to military action, it must be presumed to be civilian (*Art 52(3) API*), even in contact areas (*ICRC API Commentary, para 2034*).

The obligation of parties to armed conflict to take constant care to spare the civilian population, civilians and civilian objects in all military operations (*Art 57(1) API; CIHL Rule 15*) is of particular importance when it comes to nuclear power plants. Given the risk of release of radiation and consequent grave effects on civilians, parties need to exercise extreme caution when conducting troop movements, maneuvers and other military activities in the vicinity of such facilities.

Beyond the protection offered by the rules applicable to all civilian objects, nuclear power plants enjoy specific, heightened, protection, as discussed in more detail below (*Art 56 API, Art. 15 APII and CIHL Rule 42*).

Can military objectives be located at or in the vicinity of nuclear power plants?

Considering the grave risks inherent in nuclear power plants, parties must endeavor to avoid locating military objectives, such as troops, weapons or military vehicles, at or in the vicinity of nuclear power plants, except for the sole purpose of defending the power plant from attack (*Art 56(5) API*). Although not an absolute prohibition, such colocation should in principle not take place. While appropriate planning at the time of building these facilities should aim at avoiding such risk, it may be the case that a military objective, such as a strategically important bridge or works of the defence industry, is located in the vicinity of such facilities, or that the plant finds itself close to moving frontlines.

If a party to an armed conflict considers it has no option other than locating a military objective at the plant or in its vicinity for reasons other than its defense, it must still bear in mind general IHL rules protecting civilians against the danger arising from military operations (e.g. *Art 57(1) API; Art 58 API; Art 13(1) APII; CIHL R22-24*). For example, it must locate such a military objective in the vicinity of the plant rather than at the plant itself, if feasible.

What precautionary measures must the party that controls a nuclear power plant take?

The party to the conflict that controls a nuclear power plant has an obligation to take all feasible measures to prevent the release of dangerous forces, even prior to an incoming attack, and to refrain from any action that would risk such release (e.g., *Arts 57(1) and 58(c) API; Art 13(1) APII; CIHL Rules 15, 22 and 42*). In situations of *occupation*, they must take all the measures in their power to ensure public order and safety (*Art 43 Hague Regulations*).

Such measures must include as a matter of priority those enabling the safe and secure operation of the power plant, notably: ensuring the functional maintenance of critical components, including back-up generators; ensuring operational staff can access the plant and/or critical components and are able to perform their tasks without undue restrictions, physical or psychological coercion, or any other form of unlawful treatment, and ensuring proper food and hygiene standards; if the safe and secure operation of the facility cannot be guaranteed, shutting down the power plant partly or fully (with due consideration to the impact this would have on civilians, notably on electricity provision and subsequent availability of clean water and heating, etc.).

While the primary aim must remain to prevent the release of dangerous forces, precautionary measures also include: establishing an early warning system for the civilian population that may be affected by an eventual radiation leak (including the civilian population under control of the adverse party, to the extent feasible); taking preparedness measures for evacuation prior to or following a nuclear accident; distributing in advance iodine tablets to the civilian population; providing risk education and safe behaviour information; and, in extreme circumstances, evacuating the civilian population from the areas surrounding the power plant.

Can nuclear power plants be attacked merely because they are used by one party for military purposes?

The answer to this question is: no.

The protection of nuclear power plants does not cease merely because they become *military objectives*. This is because IHL provides an additional layer of specific protection against direct attack and incidental harm for certain works and installations containing dangerous forces, namely: dams, dykes and nuclear electrical generating stations (*Art 56 API; Art 15 APII; CIHL Rule 42*). The ICRC *recommends* (p. 69) that these rules be applied to other installations containing dangerous forces, such as chemical plants and petroleum refineries.

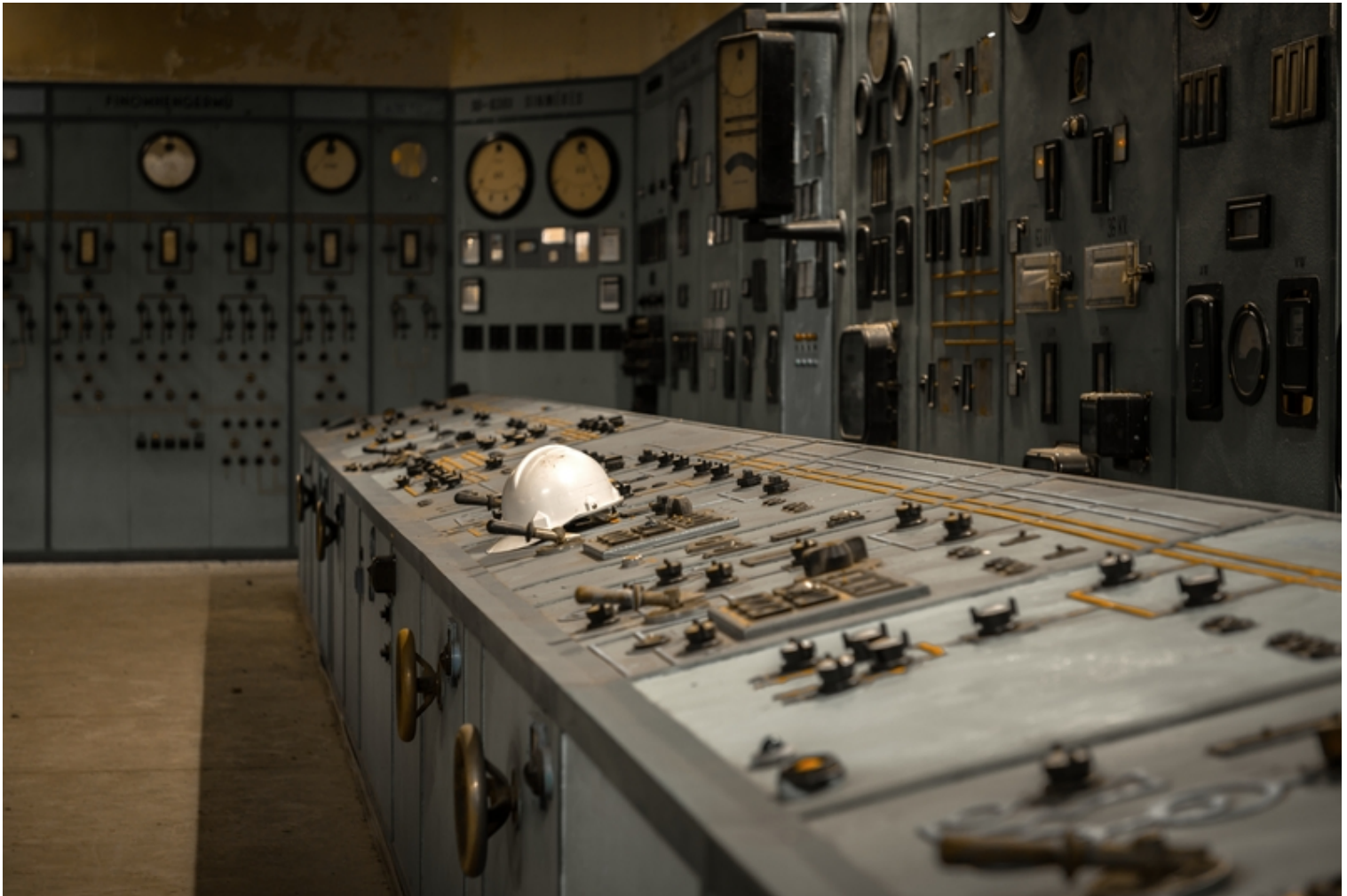
Save for exceptional and narrowly defined circumstances during an international armed conflict (discussed further below), IHL treaty law strictly prohibits attacks against nuclear power plants no matter how important the anticipated military advantage may be (*Bothe, Partsch, Solf API Commentary, 2.5.2-2.5.3, p. 396*).

In particular, both Additional Protocols provide that nuclear power plants must not be attacked even where they are *military objectives*, if such an attack 'may cause the release of dangerous forces and consequent severe losses among the civilian population' (*Art 56(1) API and Art 15 APII*). Nor can they be

made the object of reprisals (*Art 56(4) API*). Under certain conditions, launching an attack against a nuclear power plant may constitute a war crime (*Art 85(3) API*).

Under AP I, this specific protection extends to those military objectives either located at the nuclear power plant or in its vicinity (*API Art 56(1)*), as attacking such objectives entails a risk of causing incidental damage to the power plant, which can be high particularly if means of methods of warfare with wide area effects are used. This specific protection applies in addition to the general rules on conduct of hostilities such as on distinction, proportionality and precautions.

At a minimum, customary IHL mandates that both attacking and defending forces must take particular care if nuclear power plants and other installations located at or in their vicinity are attacked, in order to avoid the release of dangerous forces and consequent severe losses among the civilian population (*CIHL Rule 42*). Taking particular care will involve notably factoring into operational planning the uniquely high risk of harm to civilians and the natural environment when applying the rules on *proportionality* and *precautions* in attack and against the effects of attacks.



How to assess when an attack ‘may cause the release of dangerous forces and consequent severe losses among the civilian population’?

The proscription on attacks under *Art 56(1) API* and *Art 15 APIII* must not be equated with the proportionality rule (*Art 51(5)(b) API*; *Rule 14 CIHL*). The former rule imposes an absolute prohibition based on whether two things are objectively foreseeable: first, whether the attack may cause the release of dangerous forces; second, whether the release of dangerous forces may cause ‘severe’ losses among the civilian population. Whereas in the rule on proportionality the standard is relative, based on an assessment as to whether the incidental loss of civilian life, injury or damage to civilian objects may be expected to be excessive in relation to the concrete and direct military advantage anticipated from an attack.

Parties to armed conflicts must start from the factual premise that an attack on a nuclear power plant or on targets located at or in the vicinity of such facility brings with it significant risk of release of dangerous forces and consequent severe losses among the civilian population. This is because of the inherent risk nuclear power plants represent already in peacetime, the fact that their operational safety and security is likely to be hampered during conflict, and the danger entailed by the destructive power of the means used in warfare.

It is worth emphasizing that it suffices that the attack *may cause* such consequences; they do not need to be expected in the circumstances. The burden therefore lies on the attacking force to establish the absence of such a risk or, in other words, that an attack cannot cause the release of radiation and consequent severe losses among the civilian population (*ICRC API Commentary, para 2153*).

The assessment of whether an attack may cause the release of dangerous forces and consequent severe losses must be made in good faith based on objective elements. This includes, for example, the means and methods planned for the attack; the physical integrity of the plant; the functionality of safety and security systems; the extent of already existing disruptions to the plant’s maintenance, for example from a lack of, or constraints on, qualified

operations staff, or supply chain issues; whether there is a secure off-site power supply; the amount of dangerous forces that may be released by the attack; the proximity of inhabited areas; population density; whether there exists effective monitoring systems and emergency preparedness and response measures; the specificities of the surrounding land; and the potentially decades-long duration of the adverse effects of radiation release including on the health of civilians and the natural environment (see *ICRC API Commentary, para 2154*; *ICRC APII Commentary, para 4821*).

Given the intrinsic dependence of civilian populations on the natural environment, it will be necessary to consider the extent to which the release of dangerous forces may damage the natural environment's capacity to sustain the life of the civilian population. For example, the release of radiation would result in contamination of surrounding land and water supplies with radioactive particles and the dispersal of dirt and soot affecting the atmosphere and climate. This would likely have a severe impact on farming and food production, potentially putting communities at risk of starvation or radiation-caused illnesses (ICRC Guidelines on the Protection of the Natural Environment in Armed Conflict, p 69; see also *ICRC Briefing Note on Starvation, Hunger and Famine in Armed Conflict*).

While the parties concerned may not have access to all this information at the time of planning or deciding upon an attack, the law, and the gravity of the consequences for civilians and for the environment in the event of a radiation leak, dictate that parties err on the side of caution and refrain from attacking unless they can ascertain that the attack will not cause the release of dangerous forces (e.g. because the damage caused by the attack is limited to non-critical components) or that severe losses will not occur.

It is important to note that the 'severe losses' among the civilian population may not be immediate. Many radiation-induced lethal illnesses manifest months, if not years, after the exposure, and yet would in many cases be a direct result of the release of dangerous forces. Many more losses would be caused because of consumption of contaminated food and water. The short- and long-term effects of radiation on human health have been established scientifically. It would therefore be reasonably foreseeable that, depending on the distance from the nuclear power plant, a certain percentage of the population will die instantly or in the short term, while another percentage will develop severe illnesses, in several cases leading to death, as a result of radiation exposure. Such losses must be taken into account in the determination of the legality of an attack which may cause the release of radiation.

Are there ever any circumstances in which nuclear power plants – or military objectives in their vicinity – could nevertheless be attacked?

While absolute for nuclear power plants during a non-international armed conflict in which the Second Additional Protocol applies, the special protection for nuclear power plants – or military objectives located at the plant or in its vicinity – afforded by the First Additional Protocol may be lost under very exceptional and narrow circumstances. Even then, that does not mean that an attack against such objects will be lawful.

A nuclear power plant – or military objectives located at or in its vicinity – will lose its protection against direct attack only if it provides electrical power – or, respectively, are used – in regular, significant, and direct support of military operations, and if such attack is the only feasible way to terminate such support (*API Art 56(2)(b)-(c)*).

In such cases where the highest human interests are at stake, the decision to deprive such objects of protection should only be taken at the highest levels of command (*ICRC API Commentary, 2159*).

At the same time, given the grave risks for civilians inherent in such facilities, parties to the conflict should avoid, to the maximum extent possible, using nuclear power plants for military purposes, as this would risk loss of protection and expose the power plants to attacks by the adversary.

What is meant by 'regular, significant and direct support of military operations'?

To be clear, the 'regular, significant and direct support of military operations' cumulative threshold is significantly higher than that required for an object to qualify as a military objective within the meaning of IHL (*Art 52 API*; *CIHL Rule 8*). In short:

- **Regular:** Accidental or sporadic provision of electric power or use will not deprive such objects of their specific protection; there must be continuity, or at least this must often be the case.
- **Significant:** The level of support must be sizeable and have a real, effective and important impact on the military operation.
- **Direct:** The relation between the act and its effect must be close and immediate. The support must benefit military operations themselves and not merely intermediary objectives which themselves would be related to such operations (*ICRC API Commentary, para 2162*). For example, merely supplying electricity to an integrated grid with pooled generating capacity upon which the military relies does not constitute direct support of military operations. Nor does a nuclear power plant delivering electric power to industrial works of the defense industry. Considering the practical challenges of identifying the source of electricity in an integrated electricity network, the party will have to exercise special care to ascertain that the NPP makes a close and immediate contribution.

What is meant by 'the only feasible way to terminate such support of military operations'?

Even when the higher threshold of regular, significant and direct support of military operations is reached, an attack against a nuclear power plant – or military objectives in its vicinity – must be the only feasible way to end this support.

One way other than an attack to terminate such support could be through giving a warning setting a time-limit, similar to what is required to discontinue the protection of medical units used to commit, outside their humanitarian function, acts harmful to the enemy (see *Art 13 API*). Even if such warning is unheeded, in the case of a nuclear power plant there must be no other way of neutralizing the power supply. For instance, while not without risk, it might be possible to stop electricity

reaching the destination where it is used for military purpose by neutralizing specific elements of the distribution network (*ICRC API Commentary, para 2166*). Targeting such downstream elements of the distribution network rather than the nuclear power plant may also be required by the precautionary obligation in terms of target selection (*Art 57(3) AP I; CIHL Rule 21*).

What happens if the specific protection afforded to nuclear power plants – or military objects at or in their vicinity – is lost?

Even when these objects lose the specific protection under the First Additional Protocol, all other customary and treaty IHL rules protecting the civilian population from the effects of hostilities, as well as the *natural environment*, continue to apply. Furthermore, all parties must take all practical precautions to avoid the release of radiation (*Art 56(3) API; (Bothe, Partsch, Solf API Commentary, 2.7 p399)*).

In particular, even in exceptional cases where a nuclear power plant loses its specific protection, it is difficult to envisage in practice that an attack causing radioactive contamination that is unpredictable and dependent on meteorological conditions would comply with IHL, and in particular with the rule of proportionality (*Art 51(5)(b) API; CIHL Rule 14*) and the obligations of precautions in attack (*Art. 57 API; CIHL Rules 15–21*). The latter will notably include the choice of appropriate means and methods of warfare, including avoiding the use of explosive weapons that would, under the circumstances, have wide area effects and put at risk of impact the nuclear power plant or any of its critical components, as well as the power distribution lines providing electricity for its operation.

Is a party in control of a nuclear power plant allowed to defend it from attack?

As discussed above, parties must endeavor to avoid locating military objectives at, or in the vicinity of, nuclear power plants. AP I does, however, allow military installations (which must be understood as encompassing the weapons and troops guarding them) for the sole purpose of defending the facility from attack, provided they are only used for defensive actions necessary to respond to attacks against the protected facility, and that their armament is limited accordingly (*Art 56(5) API*).

What is necessary for such defensive action will likely depend upon a range of factors, including the proximity of the power plant to the combat area, as well as the capabilities and assessed intent of parties. For example, in circumstances where the power plant is close to the hostilities, a party might think it necessary to deploy a military guard equipped with light individual weapons along with anti-aircraft measures (*ICRC API Commentary, paras 2173–2176*). The decision on where to locate these defensive installations should depend not only on military considerations, but also on the need to minimize the risk of damage to the plant in case they are attacked or otherwise involved in fighting; they should be located as far away as feasible from radioactive material (e.g., reactors and tanks storing spent fuel) and from buildings or other infrastructure critical for the safe and secure functioning of the plant.

Further, what constitutes a response to attacks on the nuclear power plant may vary, and the determination may not always be straightforward. While counter-battery fire to neutralize enemy firing positions from which attacks are being launched on the plant constitutes permissible use of such installations, it may for instance be difficult for those employing anti-aircraft measures to distinguish between approaching enemy aircraft merely intended to pass the nuclear plant en route to another military objective, from those intending to attack the power plant itself. The identification of aircrafts that may be so attacked must be done with particular care, to avoid attracting fire on the plant from aircraft that actually were simply en route.

Are there any additional measures that Parties to the conflict can take to protect against the release of radiation and severe losses?

Further agreements and demilitarized zones

IHL urges Parties to conflict to conclude further agreements among themselves to provide additional protection for objects containing dangerous forces such as nuclear power plants (*Art 56(6) API*; on special agreements, see also Arts 3 and Art. 6/6/6/7 common to the 1949 GCs).

This might include, for example, a special agreement to establish a demilitarized zone whereby parties to armed conflict expressly agree not to occupy or use a delineated area around the power plant for military purposes, nor to attack it. (*Art 60 API; CIHL Rule 36*). Such zones can be established in peacetime, as well as during armed conflict. The purpose of demilitarized zones is humanitarian and not political (*ICRC API Commentary, para 2303*).

IHL provides a *framework* for the terms of an agreement on a demilitarized zone (e.g. geographic limits, methods of supervision, who may enter), which should be tailored to each specific situation. They can be negotiated between the parties to armed conflict directly or through an intermediary like the ICRC. Importantly, the creation of such a zone does not, in any way, affect the protection that people and objects outside these areas benefit from under IHL.

Should one of the parties commit a material breach of the agreement establishing a demilitarized zone, the specific protection afforded to the area as a demilitarized zone will cease. However, whenever possible, prior warning should be given in order to allow the party alleged to have committed the breach the time to remedy the situation and put an end to the breach (*ICRC API Commentary, para 2316*). And in any case, the general protection afforded to civilians and the specific protection for installations containing dangerous forces would continue to apply.

Marking and identification

To facilitate the identification of nuclear power plants, the parties may mark them with a special sign consisting of a group of three bright orange circles placed on the same axis, as specified in *Art 16, Annex I to API*. As foreseen by *Art 56(6) API*, the parties may also agree on additional means of identification to the marking prescribed, such as, for example, the transmission of radio or electronic signals (*ICRC API Commentary, para 2316*). The identification retains the same function and purpose in case a party to a non-international armed conflict decides to use it (*APII Commentary, para 4824*).

Special protection for works or installations containing dangerous forces is due even if they are not marked. That said, it is likely to be in the interests of a party to the conflict which wishes its dams, dykes or nuclear electrical generating stations to be respected to mark them as clearly as possible and communicate a list of them with their geographical location to the adversary through the intermediary of the Protecting Powers or organizations such as the ICRC (*Art 56(7) API* and *ICRC API Commentary, para 2182*).

Finally, in some circumstances, the deliberate misuse of the special sign may constitute a grave breach under *Art 85(3)(f) API*.

Conclusion

Fighting in and around nuclear power plants entails a high risk of devastating short- and long-term effects for civilians and the natural environment. If a nuclear power plant is directly or incidentally damaged, the release of lethal radiation is very likely, and impossible to control in time and space.

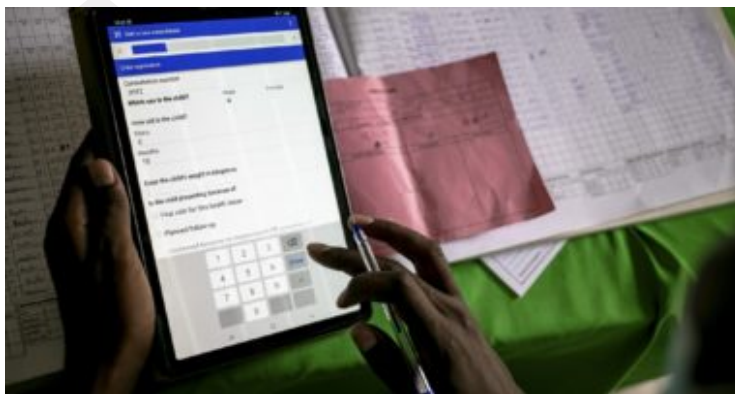
In light of this risk, IHL establishes an elaborate framework governing the protection of nuclear power plants during armed conflict, whose object and purpose is to prevent that such facilities become battlegrounds. Parties to armed conflict have an obligation to interpret and apply these rules in good faith, so as to avoid to an absolute minimum any military activities at or in the vicinity of nuclear power plants. In any case, belligerents must, in the planning and conduct of operations, be guided by the imperative to prevent a nuclear accident, which could have catastrophic consequences on the health and wellbeing of populations for years to come.

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