ISCN/JAEA-IAEA Online SSAC Training Development

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ABSTRACT

Integrated Support Center for Nuclear Nonproliferation and Nuclear Security (ISCN) of Japan Atomic Energy Agency (JAEA) in cooperation with the International Atomic Energy Agency (IAEA) executed the first online regional training course on the State System of Accounting for and Control of Nuclear Material (Online RTC- SSAC) from 9 to 20 November 2020. JAEA and its predecessor organizations have held RTC-SSAC every year since 1996 in in-person style for supporting the capacity building in the IAEA member states, however; COVID-19 pandemic posed a serious impact on implementing conventional in-person training in 2020. In addition to that, ISCN had recognized potential benefits of developing the online SSAC course as it can supplement the in-person course. With this background, ISCN/JAEA in cooperation with IAEA initiated the development of the online RTC-SSAC in April 2020. This paper provides a summary of the experience in developing the first Online RTC-SSAC including the steps taken to transition the course from an in-person course to an online course. It also identifies good practices that were established during the conduct of the two-week course as well as lessons learned to integrate into future courses. The paper concludes with a look at the future of online training and possible next steps to ensure that it will support the needs of the IAEA Member States.

INTRODUCTION

ISCN/JAEA has been leading the capacity building support activities for nuclear security and safeguards primarily for nuclear emerging countries in Asia region since its establishment in 2010. One of its major engagements for safeguards is SSAC training course conducted in Tokai, Japan, every year in cooperation with IAEA. In 2020, SSAC course was originally planned to be conducted in November as an in-person training, however; reflecting the COVID-19 pandemics and associated travel restrictions, ISCN decided to hold it as an online event for the first time and initiated its development in April 2020 together with RTC on Physical Protection of Nuclear Materials and Nuclear Facilities (PP-RTC) which is one of the ISCN's primary engagements for nuclear security [1].

1. TRANSITION FROM IN-PERSON TO ONLINE

1.1 ISCN's approach for the development of online RTC-SSAC

The development of online RTC-SSAC has been carried out as a joint effort between IAEA/SG/CP/CTR and ISCN/JAEA. It came under the Member State Support Program (MSSP) task 20/CTR-005 "Online Course Development Consultation" in September 2020. It was agreed that IAEA to offer its open Learning Management System (LMS) known as Cyber Learning

Platform for Network Education and Training (CLP4NET), ISCN to host the web meeting platform, and IAEA and ISCN to jointly design the course, develop the materials and play roles as instructors.

It was decided to develop the online curriculum by converting the in-person curriculum that both of ISCN and IAEA has extensive experiences [2].

1.2 Course format

The table 1 compares in-person SSAC course and online RTC-SSAC in 2020.

Table1 Comparison of course format between in-person and online

	In-person (1996-2019)	Online (2020)
organizer	- ISCN/JAEA - IAEA/SG/CP/CTR	
Course objective	To provide participants with a basic understanding of the nuclear non-proliferation regime and international safeguards, and with the practical knowledge and skills required to establish, operate and maintain a SSAC that fulfils the state's safeguards obligations.	
Target	State authorities responsible for safeguards and/or operators responsible for nuclear material accountancy at a facility / LOF / other relevant installation in the ISCN's target countries in Asia region.	
Course period	11 days (including 2-day visit to Nagasaki/Hiroshima)	10 days (not including time for pre-requisite/e-learning)
Hours/day	6-7 hours (9:00-17:00 JST)	3 hours (16:00-19:00 JST)
Minutes/module	45-90 min	Max. 45 min (initial)
The number of modules	Thematic modules: 8 Submodules: 51	Thematic modules: 5 Submodules: 24
Capacity of participant	24	16
Venue	JAEA site in Tokai, Japan	N/A *Broadcasted from JAEA site in Tokai, Japan
The number of instructors	JAEA: 8-9 IAEA: 7-9	JAEA: 8 IAEA: 13
The number of technical staffs	JAEA: 3-4 IAEA: 1	JAEA: 9 IAEA: 2

We decided to conduct the online RTC-SSAC in two-week period that the in-person course was originally planned to be undertaken. Fundamentals of the course such as course objectives and the target audience were maintained. Other elements were changed including the capacity of the participants and the number of instructors/technical staffs involved. The details will be explained later.

1.3 Structure of Online RTC-SSAC

Fig 1 illustrates the structure of the online RTC-SSAC. It consists of modules of self-paced learning (EL: E-learning) and of real-time live sessions (IL: Interactive Learning). The ELs were provided in various forms such as videos or reading materials as prerequisite or homework assignment that the

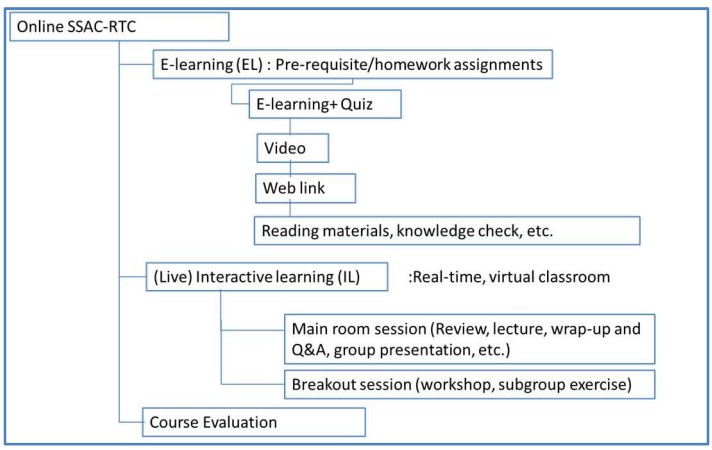

Fig.1 Structure of Online SSAC-RTC

participants were required to complete before the corresponding IL modules start. IL modules including live lectures and workshops were conducted in two-week period through the web meeting tool, Zoom meeting. The participants were also required to provide the feedback through course evaluation.

2. STEPS TAKEN FOR THE DEVLOPMENT OF ONLINE RTC-SSAC

The development of the online RTC-SSAC was carried out based on the Systematic Approach to Training (SAT) [3]. We reviewed the existing in-person SSAC course along with the five phases defined in SAT i.e. analysis, design, development, implementation, and evaluation, and adjusted them to be effective in online setting. The steps that we found particularly important are described below.

2.1 Terminology

Terminology was the first barrier that we faced right after starting the internal discussion for the online training development. We noticed that even within ISCN, related terms were used in various ways. For instance, some used the term "E-learning" specifically meaning the self-study contents that are typically provided through LMS while others used the same term for any virtual trainings provided via internet. Therefore, as the very first step, ISCN worked on defining the related terms. Although the common terminology was built within ISCN, it was found that this terminology was not consistent with that of IAEA/SG/CP/CTR. For example, ISCN called "Interactive learning" for the real-time, live sessions provided via web meeting tools while IAEA called it as "virtual classroom". ISCN and IAEA exchanged its own terminology and built the common understandings.

2.2 Course Design

1) Course objectives and learning objectives

As described in 1.2, ISCN and IAEA agreed that the course objective of in-person course can be maintained even in the online format by combining E-learning (EL) with Interactive learning (IL). We streamlined the curriculum of in-person course for online by 1) reviewing learning objectives and contents of each module, 2) merging modules with duplicative objectives and/or contents (though this duplication is effective in the in-person format), 3) re-defined learning objectives for restructured modules, 4) make sure that, with the restructured curriculum, the overall course objectives can be achieved.

2) Program: combination of EL &IL

The length of time that people can stay focused on online lectures was considered to be shorter than in-person lecture. Therefore, originally, we limited the length of one module to 45 minutes and the length of one day to three hours. IL modules were scheduled from 16:00 to 19:00 JST as shown in Table 1, considering the time difference between Vienna, Austria and Asia. In order to achieve the course objectives in an effective manner, we decided to undertake the followings;

- Conservative capacity of participants; 16 (four in each sub-group for workshops) while it was 24 (six each) in the traditional in-person format. It allows instructors to make sure that all

the participants are engaged, if there are any, help them who look struggling.

- Most of the lectures were provided as EL so that the participants can work on their own timing as prerequisite or homework assignment outside the IL time-frame.
- On the assumption that all the participants will have completed the corresponding EL modules, IL will focus on "interactive" sessions including the review of ELs, Q&A, quiz-type workshops, scenario-based discussions, etc.

In accordance with the principles above, ISCN and IAEA defined appropriate modality either EL and/or IL and the specific delivery method for each module as Table 2 shows examples.

Table 2 Example modality (delivery method) for major contents of online RTC-SSAC

Major Contents	Delivery method for in-person	Delivery method for online
Lecture	・Lecture using PPT	・PPT with narrative/Lecture video(EL) ・Zoom main room(IL)
- Quiz	・E-voting system called "Clicker" (See Fig.2) added in PPT	・Quiz incorporated in E-Learning (EL) ・Zoom polling(See Fig.3) (IL)
- Q&A	・Verbal communication	・Forum on CLP4NET (EL) ・Verbal or chat at daily wrap-up and break time (IL)
Workshops	・Subgroup exercise	・Subgroup exercise using Zoom breakout function (IL)
KMP/MBA, spent fuel verification demonstration	・Virtual reality system	・Virtual Reality two-dimensional video with narrative (EL)
DIQ exercise	・Facility visit to JAEA research reactor and associated subgroup exercise	・Virtual Tour of the JAEA facility and associated exercise using Zoom breakout
NDA and C/S Demonstration	・Hands-on exercise using NDA and C/S equipment	・Video recorded by IAEA(EL) ・Live demonstration by IAEA/TRO (IL)
Nagasaki/Hiroshima visit	・Historical tour to bombed area	N/A

3) Selection of web tools

IAEA CLP4NET was selected as the platform for sharing ELs as it has been used for in-person SSAC course for years and proved its user-friendliness. CLP4NET is Moodle-based LMS which enable the participants to work on E-learnings, exchange files, and communicate with other participants and instructors through a message board called "Forum". We selected Zoom meeting as the platform to execute ILs, because of its good response, useful functions (chat, breakout, annotation, polling, etc.) and user-friendliness.

2.3 Material Development

The training materials of both ELs and ILs were developed with an emphasis on achieving the leaning objectives. The examples of materials for EL and IL are as follows;

1) EL

- Lectures
  - PowerPoint-based lectures with narrative
  - Pre-recorded lecture videos

  - Incorporated quizzes ensuring the knowledge retention and motivating the participants
- "Basic Training Course on IAEA Safeguards"
  - An independent E-learning course developed by IAEA available on CLP4NET/NUCLEUS [4]
  - Providing the general understanding of IAEA safeguards
  - Incorporated in Online RTC-SSAC course as a pre-requisite
- Demonstration Video
  - Filmed NDA measurement and C/S demonstration
- Virtual Reality (VR) video
  - Two 3D VR contents, 1) material flow and MBA/KMP structure and 2) spent fuel verification of the hypothetical nuclear power plant were converted to 2D videos with narrative
- Zoom guidance video
  - A short video of introducing Zoom functions enabling the participants familiar with it
  - A specific guidance for this course focusing on the functions to be used in the ILs

2) IL

- Live lecture
  - PowerPoint lecture materials including slides for discussions with participants intending to use "Polling", "Annotation", "Chat", etc.
  - Breakout function for sub-group exercise (workshops)
- Daily Wrap-up/ Quiz-style Workshop
  - Used Zoom "Polling" for quiz (Fig.3) instead of using E-voting for in-person (Fig.2)

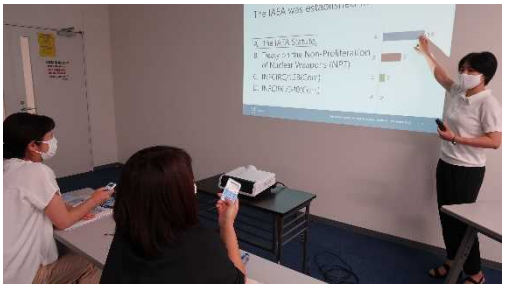

Fig 2.E-voting system for in-person course

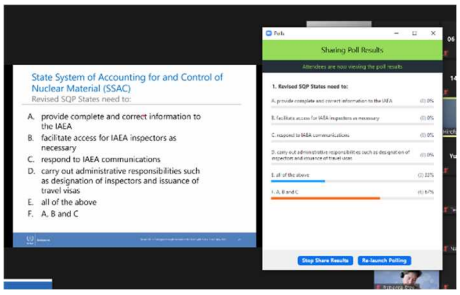

Fig 3. Screenshot of Zoom "Polling" for online course

- Scenario-based exercise
  - Scenario-based exercise to define MBA and KMPs of a hypothetical facility or illustrate a possible flow of the information based on the given scenario
  - Annotation function to draw on the shared screen for effective facilitation and taking note

(See Fig4)

- Breakout function for settlement of sub-group exercise

- Design Information Questionnaire (DIQ) Exercise
  - DIQ exercise using the virtual tour (VT) of a JAEA research reactor
  - The VT built with 4K high resolution and 360° photos to engage the participants with reality [5]

Fig 4. Screenshot of Sub-group exercise

3. IMPLEMENTATION OF ONLINE RTC-SSAC

3. 1 Connection test

Connection test was conducted inviting all the participants, instructors and observers a week before the course starts. The functionality of audio and video were checked, and Zoom guidance was presented by the ISCN technical staffs including the demonstration and practice session of its functions.

3.2 Course Execution

1) Broadcasting environment

For stable broadcasting;

- All the PCs and headsets were connected with wire for ensuring stable connection
- Back up host computer was set up in a different venue in case of failure of the main host

For supporting the instructors to give lecture and facilitate the exercise,

- A large conference room was used for the broadcasting station where all the instructors and technical staffs in ISCN gathered for smooth and direct communication while keeping social distancing (see Fig.5).
- During subgroup exercises, a facilitator, co-facilitator and technical staff were assigned to each sub-group. Each group was set up with a good distance from each other for minimizing the interference by the voices (see Fig.5 and 6)
- Multiple screens including large one were used so that the instructors can see all the necessary information at a time e.g. training material, participants' camera views, chat box, list of the people logged in, and participants' view (see Fig. 6).
- In order to make sure that material is viewed appropriately, one screen shows the participants' view by logging in with an account enrolled as a participant.

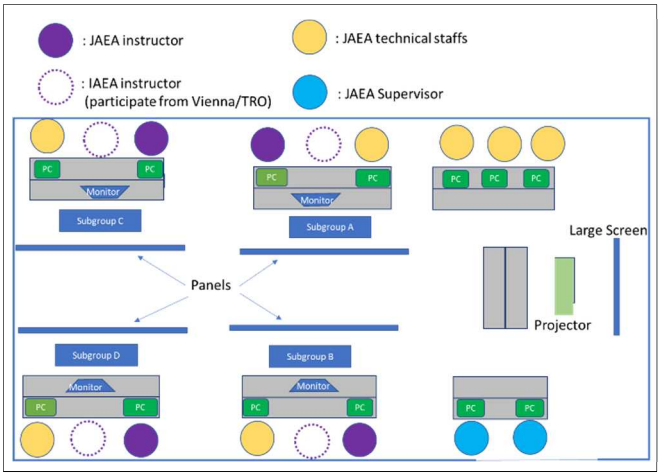

Fig 5. Image of the floor plan of broadcasting station

- Technical assistants supported instructors by sharing screen, launching the polling, monitoring the chat, reaction, or hand raised by the participants.

Fig 6. Photo of broadcasting station

Fig 7. Photo of broadcasting station (subgroup)

4. FINDINGS FROM THE COURSE DEVLOPMENT AND IMPLEMENTATION

4.1 Feedback from the participants

Feedback was collected from all the sixteen participants using Course Evaluation Questionnaire prepared by ISCN and IAEA. The results are summarized in Table 3.

Table 3. Summary results of the course evaluation of online RTC-SSAC

	Summary results of the course evaluation
Overall satisfactory	Strongly agree: 12, Agree:4, Disagree:0, Strongly Dsagree:0
Usability of LMS and Zoom meeting	- Instructions were clear, no difficulties in use of CLP4NET or Zoom - Zoom functions e.g. annotation and chat were useful to ask questions
Course as a whole	- Combination of EL and IL was effective - Online course requires more self-motivation and time management skill while it is extremely cost-effective and can be utilized efficiently
EL modules	- EL helped acquire necessary knowledge to be well prepared for IL - EL helped retain the knowledge by working on multiple times - There were days with too much homework assignment to cover - EL materials should be provided earlier - Some ELs are too large to run with Wi-Fi - More quizzes are preferable
IL modules	- IL helped us motivated to work on further ELs - IL exercises/workshops provided practical experience and knowledge - Time allocated for exercises/workshops was too short - Wish to treat NDA

All the sixteen participants chose strongly agree or agree to the question if the course was satisfactory. At the end of the course, fifteen quizzes were posed to the participants to confirm their knowledge retention. The overall percentage of the correct answers was 80 %, which demonstrates that the course effectively achieved the learning objectives.

There were several participants who stated the combination of EL and IL was effective; EL can be paused anytime and repeated until they can really understand while IL, especially subgroup exercise, brings practical experience and knowledge. It was also noted that time allocated to each exercise was too short, though many of participants found it effective enough.

4.2 Good practices and lessons learned

Major good practices and lessons learned from design, development, execution and evaluation of the online RTC-SSAC are described below.

1) Importance of common terminology

It is the essential first step to build the common understanding on the terminology amongst the people involved. It becomes even more important for a joint effort involving multiple organizations.

2) Dry-run, Dry-run, and Dry-run

Dry-run was a vital step for providing qualified ILs due to their time constraints. For instance, some subgroup exercises needed more than one instructor assigned to each group, e.g. a main facilitator to stimulate the discussion and a co-facilitator to share screen via Zoom and take note. In such a case, all the instructors should join dry-runs to understand one's own role and be well prepared by becoming comfortable using related Zoom functions with all the associated materials downloaded, opened and ready to be shared on the PC. It was also important to have all the technical staffs present at the dry-runs so that they can understand the flow of each module including who to share the material, when to launch the polling or to open breakout rooms, etc.

3) Qualified technical assistants

It was fortunate for ISCN having qualified and skillful technical staffs, which was one of the keys for the successful implementation of the online course. They were responsible in Zoom host and its associated technical assistance; they communicated with participants who encountered technical issues through chat or phone call and jointly solved the problems while lectures or workshops were not intervened. It resulted in that 100% of participants could join the course from the beginning to the end, overcoming the connection issues.

4) Effective materials for IL workshops

We found that it was not effective to virtually share multiple files at a time because the letters become comparably small and the operation become complex. Considering this difficulty, exercise materials used for IL workshops such as scenario, floor map, and other reference materials were merged into one file. In addition to that, participants were asked to read the scenario beforehand and/or print it out so that they can refer to anytime they want to during exercise. It contributed to the smooth and effective implementation of the exercises.

5) More experts can be involved

Compared to in-person course, more IAEA subject matter experts were involved as instructors because there was no need to travel, which is an advantage of online training.

6) Development of VT

The VT of a research reactor with the guide by facility operators played an essential role in the DIQ exercise that helped participants to visually understand the facility design of the plant and added practical sense to the exercise.

7) Duration of an IL module

The maximum length of one IL module was originally designed as 45 minutes considering the difficulty in staying focused on the screen. However, as indicated in Table 3, the length of an IL module can be extended especially if it is an interactive session like subgroup exercise.

8) Possible improvement of EL materials

Majority of the participants had completed ELs before the corresponding IL started, however; some of them pointed out that, on certain days, there was too much EL assignment to complete. EL materials for online RTC-SSAC were provided to the participants five days before the course started. For the future course, EL may better be provided earlier so that the participants can have sufficient time to complete the ELs.

As shown in Table 3, it was pointed out that EL highly required self-motivation and time management skills. If we can add some interactivity in EL materials by incorporating more quizzes as suggested by several participants, it may help them motivated.

9) Connection test

During the connection test, it was found that one participant could not connect to Zoom. After the test, she walked around her office with her laptop and found the area with the most stable internet connection. Thanks to her effort, all the participants were able to join the course from the very first day. It was a good practice to hold the connection test with a sufficient time for the participants to fix their problems if any.

10) Efficient learning opportunity

Online RTC-SSAC achieved learning objectives with shorter time of live sessions than conventional in-person courses by combining ELs with ILs. It was an efficient learning opportunity which did not require traveling and allowed participants to use their time with flexibility outside IL time-frame. However, to put it the other way around, the participants were not completely free from their duty or their lives during the online training as they participated from their office or home. It is an important question for online trainings how to ensure the learning environment of the participants.

5. FUTURE PROSPECT

5.1 Online RTC-SSAC in 2021

IAEA and ISCN agreed to execute another online RTC-SSAC from 29 November to 10 December, 2021. Curriculum and materials developed for the previous course are currently reviewed and revised to reflect the good practices and lessons learned from development and execution of the course. Experience of observing the online SSAC course conducted by IAEA and U.S. DOE/NNSA in June 2021 also gave us valuable input for further improving our course. Nagasaki/Hiroshima visit which was indispensable component of our in-person course is currently considered to be provided as a virtual content.

5.2 Various styles of training course

Online RTC-SSAC provided an efficient and effective learning opportunity with shorter time of live sessions than in-person course and allowed the participants to use their time outside the live sessions with high flexibility. Conventional in-person training requires the participants to leave their workplace for full two weeks, which was not an option for certain people. Online course may potentially embrace such people.

Online RTC-SSAC was structured by EL and IL, however; there are many other possible

structures; basic training course with only ELs, advanced in-person course combined with ELs provided as prerequisite to ensure that the participants have basic knowledge, etc. Based on what we have learned about online training, ISCN plans to make good use of online element for its future capacity building activities.

CONCLUSION

IAEA and ISCN developed and successfully executed online RTC-SSAC in November 2020 as the world first online SSAC course. It was developed by adjusting the curriculum and materials used for conventional in-person SSAC course to be effectively delivered in online setting. In the development phase, we found it essential to build the common understanding of terminology as the first step especially if multiple organizations are involved. Dry-run with all the instructors and technical staffs was also critical for providing a qualified online training.

Online trainings provide efficient learning opportunities which allow participants to use their time with flexibility. However, it also means that the participants cannot be free from their duty and their lives during the training, which makes it more difficult for them to concentrate on the training. In-person trainings have an advantage in this regard which provide better learning environment by having participants in the course venue, detached from their daily lives.

A lot of other lessons and good practices were learned through the development and conduct of online RTC-SSAC. Based on the experience, ISCN continues to contribute to IAEA's capacity building programs for its member states by providing effective and efficient trainings that are appropriately structured by online and in-person format.

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