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Report of On-Site Inspection Workshop-19

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REPORT OF ON-SITE INSPECTION WORKSHOP-19

Development of OSI Equipment List: Initial Period Techniques

(Baden, Austria, 16 – 20 May 2011)

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Summary

The objective of this workshop was to carry out discussions on the OSI Equipment List for the initial period techniques and to provide further contribution to the development of the OSI Equipment List. The report of the 36th session of WGB included guidance to develop corresponding concepts of operations for the equipment, identify logistics and infrastructure requirements, and to address software issues related to the equipment.

A great deal of development work related to the Equipment List and equipment specifications has been accomplished since the initial developments of OSI Workshop-6 held in June 2000. That work has been documented as lessons learned from the 2008 Integrated Field Exercise, results from many other field tests and trials (PTS INF papers and technical reports) and other OSI workshops, especially OSI Workshop-18, which directly addressed the format of the Equipment List. In addition, a new look at the current state of the Equipment List was warranted merely on the basis of technical advances and changes, such as the almost universal use of digital photography, which have taken place since the work of OSI Workshop-6. During OSI Workshop-18 a new format for the Equipment List, based upon the equipment list used by the Organization for the Prohibition of Chemical Weapons (OPCW), was recommended. Table 2 of Task Leader paper WGB/CTBT/TL-4/40, which is modelled after the OPCW format, was used on a trial basis for the new draft Equipment List for this workshop. Six working groups of experts, organized by technology, discussed the concept of operations and filled in as much of the table (which includes description, general and specific operational requirements, technical specifications, as well as certification and calibration requirements) as possible during two parallel sessions (with three expert groups meeting simultaneously) utilizing one and one-half days of work for each session. The result of this work is Annex I of this report, which is the list of equipment organized by the six technology groups. Summaries of the work of each technical expert group are provided to explain the method of work and various issues relevant to how the list was completed by each expert group session. These summaries also discuss current gaps in the list and issues that need further deliberation, with recommendations on how to resolve outstanding issues.

Contents

Abbreviations

CCD	charge-coupled device
ConOps	concept of operations
CSP	Conference of the States Parties
CSS	controled source seismology
CTBT	Comprehensive Nuclear-Test-Ban Treaty (“the Treaty”)
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization (“the Organization”)
CZT	cadmium zinc telluride
ECS	expert communication system
EGCL	Expert Group Co-Leader
GCF	Guralp compressed format
GPS	global positioning system
HPGe	high purity geranium
IDC	International Data Centre
IFE	Integrated Field Exercise
IIMS	Integrated Information Management System
IMS	International Monitoring System
IPT	initial period techniques
IR	infrared
ISP	inspected State Party
IT	inspection team
LIDAR	light detection and ranging
LSB	limited slip bolted
MCA	multi channel analyzer
MDC	minimum detectable concentration
MS	multispectral
MSEM	multispectral expert meeting
MSIR	multispectral/infrared
NG09	2009 noble gas field operations test
OPCW	Organisation for the Prohibition of Chemical Weapons
OSI	on-site inspection
PMO	Policy Making Organ
PTS	Provisional Technical Secretariat
RAID	redundant array of independent disks
RMS	removable mass storage
RNG	radioactive noble gas
SAMS	Seismic Aftershock Monitoring System
SEED	Standard for the Exchange of Earthquake Data
SOH	state of health
SOP	standard operating procedure
TBD	to be determined
TBR	to be revised
TS	Technical Secretariat
UNE	underground nuclear explosion
WGB	Working Group B
XVGA	extended video graphics array

INTRODUCTION

The objective of OSI Workshop-19 was to carry out discussions on the OSI Equipment List for the initial period techniques and to provide further contribution to the development of the OSI Equipment List. The mandate from the 36th session of WGB included guidance to develop corresponding concepts of operations for the equipment, identify logistics and infrastructure requirements, and to address software issues related to the equipment. This workshop was modelled after OSI Workshop-6, which successfully focused the work of technical experts to consider OSI equipment and began the process of defining equipment specifications. The bulk of the work of this workshop focused on reformulating the draft OSI Equipment List, following the format used by the OPCW as recommended by OSI Workshop-18. Annex I, the Equipment List as defined by this workshop for consideration by WGB, is the result of these deliberations. A great deal of background information relative to the Equipment List was compiled prior to the workshop by the PTS staff for reference and review by participants prior to the workshop; a list of this reference material is provided in Annex II.

It is generally widely noted that concepts of operations (ConOps), especially for essential inspection equipment, can be of indispensible value to guide the process of defining equipment specifications. One must know what the equipment is required to do and how it will be used before technical specifications can be refined. Initial discussions during this workshop helped to advance thinking about what a ConOps is, how it relates to OSI, mission design, field deployment, operational efficiency and application effectiveness, and that there may be a hierarchy of details contained within the ConOps that need to be well designed and developed. A brief discussion of these deliberations is given below; the interested reader should refer to the presentations made during the opening session of the workshop for more details. Note that all of the presentation and reference materials from this workshop are contained in electronic format on disk that is also available.

Summaries of the deliberations of each expert group session are also provided in this report. These describe assumptions and other issues discussed that were used to develop Annex I table entries and also highlight gaps in the list and recommendations for further work. Variability in the completeness of the Equipment List of Annex I reflects both the state of development of different technologies for OSI applications, the technical expertise available during the workshop, and the lack of an agreed concept of operations. The areas of video and still photography, seismic aftershock monitoring, visual observation techniques, and position finding are relatively complete with a relatively well-developed ConOps, while the multispectral imaging, radionuclide sampling, and radionuclide survey equipment are still in need of considerable development. The multispectral imaging technology application has benefitted greatly from a recent meeting by an expert group on the subject. Following the three days of deliberations of the six technical sessions, a general closing session of the workshop was held in which one of the Expert Group Co-Leaders (EGCLs) gave an overview of the session summary for review and comment by all participants. At that time some modifications were made by EGCLs, but the summaries generally represent a consensus of the subset of participants who attended each session. During the technical discussions of this workshop, several elements common to all or many of the technologies were identified and these elements are also discussed in this report.

This report begins with a summary of the opening and plenary sessions of the workshop, followed by summaries from each of the technical sessions, as provided by the EGCLs. This is followed by a summary of the closing session. As stated above, the main product of this report is the Equipment List for Initial Period Technologies as provided in Annex I.

OPENING AND PLENARY SESSIONS

Workshop Co-Chair OSI Director Oleg Rozhkov opened the workshop by reminding participants that the planning for the next on-site inspection (OSI) integrated field exercise (IFE14) was discussed during OSI Workshop-18 and during the 36th session of Working Group B (WGB). The issue of what equipment will be tested and used in IFE14 and for training needs to be resolved. Thus there is a need to review work to date on the Equipment List, especially that provided by OSI Workshop-6, and put the equipment into the framework provided in Task Leader paper TL-4/40, 9 February 2011, (Table 2). Co-Chair Vitaly Shchukin further defined the workshop objectives as intending to provide further contributions to the development of the OSI Equipment List for OSI initial period techniques. He further defined the work to include the following:

- Definition and refinement of equipment specifications
- Further development of the concept of operations for initial period techniques (IPT)
- Identification of logistics and infrastructure requirements for core equipment
- Addressing software issues related to IPT equipment

In their initial presentations, Co-Chair Shchukin and Co-Chair Wang Jun pointed out that the basis for the work of this workshop is a mandate from the 36th session of Working Group B "…to develop further specifications for equipment to be used in the initial period of an OSI together with corresponding concepts of operations, to identify logistics and infrastructure requirements and to address software issues related to the equipment. … these objectives are in line with its plans for the development of the list of equipment for use during OSI…" and that "…the outcomes of OSI Workshop-19 will be considered at the 37th Session of WGB." Wang referred to Table 2 of the CTBT/WGB/TL-4/40 (9 February 2011), List of Equipment for Use During On-Site Inspections, which was based on discussions, held during OSI Workshop-18, of the Organization for the Prohibition of Chemical Weapons (OPCW) Equipment List, and recommended as the basis for developing the Equipment List in this workshop. Co-Chair Gilbert Sateia referred to a flow diagram (refer to his presentation in the disk accompanying this report) that was introduced during OSI Workshop-18 that illustrates an iterative process for developing an Equipment List. The first step in the diagram refers to "expert groups make initial attempt at list". Sateia pointed out that Workshop-19 represents this stage of the process – the initial list is used to acquire equipment for testing and training and lessons learned from the process are then used to modify specifications as necessary. Sateia also provided some suggestions for incorporating a concept of operations (ConOps) into development of equipment specifications. He noted that it is particularly important to document the assumed scenario when considering ConOps and the equipment list.

Opening remarks by the workshop co-chairpersons were followed by overview presentations by Shchukin and each Expert Group Co-Leader (EGCL). Shchukin provided background for the role of the Equipment List for the development of OSI capabilities, reviewed the status of development of the list to date, and provided guidance for the use of Table 2 of TL-4/40 and the basis for development of the list for this workshop. The EGCL presentations (refer to Annex IV and the accompanying CD) provided overviews of each of the six technology sessions for reference by all participants prior to splitting up into the individual working groups. There was some discussion of the general concept of ConOps, based on Sateia's presentation and on parts of the presentation by EGCL Bowyer, who brought up the idea of layers, or levels, of ConOps based on the degree of operational detail and interdependence of objectives. There was general agreement that ConOps were important for the development of the Equipment List and that definition of levels of ConOps is an important concept that should be considered further.

The final presentation of the opening session was given by one of the workshop participants. The presentation by Mohammad Zahmatkesh, titled "Equipment Related Issues on On-Site Inspection" covered a wide range of issues related to inspection equipment, including equipment and software checking, recommendations for how the list should be developed, packing and mandate issues, and blinding (measurement restriction) issues.

Method of Work

The focus of work at this workshop was on technologies defined in the CTBT Protocol Part II, paragraphs 69a through 69e, previous work as recorded in documents of Working Group B of the Preparatory Commission (WGB) and information (INF) papers provided by the Provisional Technical Secretariat. A list of this extensive background material is provided in Annex II. A key document for the basis of this report is OSI Task Leader paper CTBT/WGB/TL-4/40 "Draft List of Equipment for Use During On-Site Inspection" (9 February, 2011). Table 2 of that paper provided the template for the Equipment List format to be completed as much as possible by this workshop.

In order to facilitate the technical focus on specific types of equipment, the workshop sessions were divided into six groups of experts as follows, with names of the respective workshop EGCLs as follows:

SESSION A Expert Group Meetings
Group A1: Video and still photography – Ashraf Abushady and Wang Jun
Group A2: Seismic aftershock monitoring system (SAMS) – Peter Labak and Vladimir Nogin
Group A3: Radioactive noble gas sampling – Rainier Arndt and Ted Bowyer

SESSION B Expert Group Meetings
Group B1: Position finding and visual observation – Mordechai Melamud and John Walker
Group B2: Multispectral imaging and infrared – Luis Gaya-Pique and John Henderson
Group B3: Rapid gamma radiation survey, radionuclide sampling and high resolution gamma radiation measurements – Junichi Tanaka and Boris Ilijas

The substantive work was carried out in two sessions of three concurrent expert groups each, with participants free to choose a group to attend most relevant to individual interests and expertise. A total of one and one-half days were devoted to each session; session B followed session A. The work of the expert groups was aimed at preliminary discussions of the ConOps for each technique followed by the group effort to complete the contents of the Equipment List table based on consideration of documented previous work and group discussion. Much of the work involved the updating of material that had not been considered by experts for several years that requires consideration of advancements in technology.

EGCLs compiled their group's findings into the table (compiled in Annex I) for each of the six technology areas. Final comments on the preparation of the table, findings, and recommendations for each area of technology were presented to the entire workshop during the closing session by one of the EGCLs for each expert group. Summaries of the work of each group, along with comments, findings, and recommendations as compiled by the EGCLs are included in the next section of this report. The fully compiled table consisting of the updated draft Equipment List for each technology, and the main product of this workshop, is contained in Annex I. This constitutes the current draft Equipment List to be considered by WGB.

EXPERT GROUP SESSION SUMMARIES

EXPERT GROUP SESSION A1: VIDEO AND STILL PHOTOGRAPHY

General Assumptions and Considerations

The goal was to update or revise the general and specific requirements and technical specifications of video and still photographic equipment as part of a draft inspection Equipment List. Discussions took into consideration all available knowledge and experience in this regard starting from 1998, represented by OSI Workshop-2 and document CTBT/WGB-6/TL-4/5 on analogue and instant hand held cameras, to the more recent results found in document CTBT/PTS/INF.865 in 2007, which changed the focus of considerations to the use of digital cameras. Relevant actions by WGB during its 26th, 27th and 28th Sessions were also taken into consideration.

Other important factors serving as the basis for the discussions include lessons learned and results of equipment testing during PTS exercises (in particular, IFE08) as well as the general consideration that commercially available digital video and still photographic equipment have reached a technically mature stage that overtakes the analogue generation of products.

Assumptions Agreed to by Participants

- For all inspection equipment, core or auxiliary, the starting premise should remain with the Treaty, OSI requirements, best knowledge, commercial availability as appropriate, and relevant concepts of operations and application procedures found in the OSI Operational Manual and other documents.
- Video and still photographic equipment are part of the complete suite of OSI equipment to be approved by the first Conference of States Parties for use during an OSI. Pending such approval, the list of equipment as defined here will continue to be for testing and training purposes, including for use during exercises.
- Neither a specially built aircraft-mounted camera nor an instant camera would be addressed. It is understood that the viewing screen and playback function of a digital camera can serve the purpose of an instant camera. Also excluded would be infrared (IR) cameras, or charge-coupled device (CCD) cameras, as they are covered under multispectral techniques as a separate technique per paragraph 69 of the Treaty protocol.
- Still photographic equipment assumes different technical requirements for ground based and aerial use and therefore requires different cameras.
- There is a realistic need to switch completely to digital technology for video and still photographic equipment. At the same time, relevant specifications should be based on sufficiency for operational needs and cost efficiency, while leaving a reasonable opening for future technical updates.
- Removable mass storage (RMS), when removed from the camera should be regarded as the "photographic originals", as referred to in the Protocol of the Treaty, and any reproductions will be regarded as "photographic products", as referred to in the Protocol. These terminology changes should be made, as needed, to the glossary of the OSI Operational Manual.

- It is agreed that the video “clip” function (ability to record a short segment of video) of a handheld digital camera will normally not be used in the field, since video recording is defined as a separate inspection technique and implemented by a separate video camera. However, there may be utility to use this function under some circumstances. It is expected that the draft OSI Operational Manual will address this issue, especially in light of findings from future exercises.

The Revised List of Video and Still Photographic Equipment

The Expert Group participants agreed on all specifications with the exception of whether to go beyond the agreed range of 24 to 85mm for the 35mm digital single lens reflex camera, leaving open the possibility for use of super wide angle and telephoto lenses for photographing objects of interest at a long distance and where human access is impossible or hazardous.

Recommendations for Action

- The list for video and still photographic equipment should be forwarded to WGB for consideration on the understanding that these specifications can be used for the PTS to procure or otherwise obtain relevant equipment for testing and training purposes as well as for the preparation and conduct of the IFE14.
- Following experience gained from the IFE14, the list and specifications may be reviewed for possible improvement.
- The format of the Equipment List table should be improved to better serve the first Conference of States Parties (CSP) in reviewing and approving equipment for used during an OSI, in light of the peculiarities of the OSI equipment regime in contrast to other comparable organizations. It is preferable to reduce the number of entry columns from 4 and 6 by shifting columns for certification and calibration to other documents of the Technical Secretariat (TS) for equipment inventory management and control.

EXPERT GROUP SESSION A2: SEISMIC AFTERSHOCK MONITORING SYSTEM

General Assumptions and Considerations

The expert group opened with presentations by Pasi Lindblom “Some Thoughts on SAMS” and Andrey Belyashov “Assessment of Mobile Telemetric Complex Possibilities in Solving SAMS Tasks”. Lindblom described the configuration of SAMS and how it can be utilized in practice. Belyashov provided an estimate of the applicability of different technical elements of SAMS equipment, including telemetry equipment based on practical experience gained in both flat and mountainous terrain. These two presentations set the tone for further discussions that focused on the primary task of developing the Equipment List for SAMS.

Labak introduced Table 2 from CTBT/WGB/TL-4/40 as the basis for discussion and eventually the list for approval by the first CSP. He emphasized that column 2 of the table addresses objectives and that column 3 addresses capabilities as defined by the concept of operations. The draft List of Equipment for Use During On-Site Inspection from the Operational Manual would be used as a basis for developing the list. Labak noted that the list needs to be developed according to the needs of OSI, and that other factors such as the commercial availability of equipment, would be addressed at a later time. He also made the following points:

- To date, certification or calibration criteria (elements of the Table 2 of CTBT/WGB/TL-4/40) have not been developed and, in any event, would be somewhat reliant on manufacturers’ specifications.
- Technical specifications pertain to those needed to accomplish the objectives of the technology and to contribute to the objectives of an OSI.
- Experts should draw on two INF papers (201 and 856) as basic sources of reference with the objective of the technology being to detect seismic events.
- The proposed equipment list is based on previous INF papers, other approved documents, current knowledge and experience gained during previous field tests, directed exercises, and IFE08.
- Core and auxiliary equipment will both be addressed in one table.

It is important to keep in mind that the purpose of SAMS is to localize the search area and facilitate determination of the character of an event. Discussion ensued regarding issues such as the maximum number of stations required in the field, taking into account real field and operational conditions, to what depth shocks will be looked for, telemetry transmission as an option instead of using stand-alone stations, and the best configuration to use when setting up a station.

Concept of Operations

Labak brought up the definition of ConOps, noting that much would be drawn from Sateia’s presentation during the plenary session and that it is important to keep in mind stakeholder (TS, ISP and IT) requirements and restrictions. He suggested that the focus of Expert Group work would be on filling in the table, and four areas were identified to assist in achieving this goal (objectives, scenario, capabilities and how to employ them).
Objectives – Shall reflect paragraph 69e of Treaty Protocol and the model text of the OM (6.5.1).

Scenario – this would be an underground nuclear explosion (UNE), including parameters of the triggering event and geological setting.

Capabilities - Detect, localize and characterize aftershocks with seismic magnitude M greater than or equal to -2.0 with the signal in the frequency band 1-100 Hz, and be capable of being maintained under field conditions.

Deliberation ensued over a number of issues, such as the impact of environmental conditions such as vegetation, topography, and weather. The influence of infrastructure, available resources, and external information was also touched on.

Views on the Content of the Equipment List

Development of the List:

Each item in the field and data equipment parts of the list was addressed and columns 2, 3 and 5 were filled out for these items. Participants decided to not address criteria for columns 4, Certification criteria and procedures, and 6, Calibration requirements, at this point, but to have a clear understanding that they still need to be developed. The term "none" was substituted for N/A in selected fields to indicate that no calibration criteria are needed.

The main criteria for filling in the table are as follows:
<u>*Developed on Three Levels*</u>

- General – The entire SAMS system
- Main Systems – Field and Data Center
- Equipment Items

<u>*Critical Points*</u>

- The list must be general enough to avoid minor unnecessary future re-approvals (for example after the equipment has undergone a minor upgrade such as an upload of new firmware)
- The list must be specific enough to enable a clear link to be made between the Equipment List for approval and the possible future Equipment List for the OSI mandate
- The list must reflect ConOps on all three levels

Work on the Equipment List in the context of ConOps led to some of the following new developments:

- Parameters for technical specifications were agreed upon for the digitizers with the understanding that changes may be made in the future.
- It was agreed that operational temperature ranges and environmental conditions need to be re-examined for all equipment (not just equipment for SAMS).
- The issue of electrical grounding was raised and it was agreed that it will need to be addressed at a later time.

Issues Discussed and Decisions Made During Deliberation:

- It was agreed to list SAMS as a system under description referencing OM 6.5.1 and paragraph 69e of the Treaty Protocol.
- It was noted that future certification specifications have to take into account functionality, including any measurement restrictions, technical specifications, and calibration requirements specified in the table.
- The number of channels for digitizers was discussed with 6 or more being decided as optimal.
- The issue of cables being categorized as equipment or not was discussed with it being agreed to list them as accessories under technical specifications as “cables with connectors”.
- The term shovel was changed to “digging tool”, since the exact need depends on the seismometer selected and emplacement conditions.
- It was agreed to include installation kits with seismometers in the table.

Note:
- Issues related to packing and storage are not addressed in this table.
- Fields that are filled with “needs to be developed” are open for further discourse.
- Health and safety equipment still need to be developed.

Open Issues (Gaps) Missing Entries and Actions that Need to be Taken

- Calibration requirements need to be established and certification criteria defined along with procedures for all three levels of the table for all items.
- There is a need to carry out further study and testing of the use of telemetry.
- The maintenance aspect needs to be addressed and decisions made as to whether maintenance needs to be in the table and, if so, where (for example in columns 3 or 5).
- Environmental conditions are a general issue for all OSI techniques, and normal and extreme conditions need to be defined.
- Use of single component seismometers, as opposed to using all three-component seismometers, needs to be re-examined.
- Hardware and software specifications for the data centre need to be modified.

<u>Gaps in the Equipment Technical Specifications Were Identified as Follows:</u>

- Digitizers – need for grounding specifications, definition of least sensitive bit, authentication capability and buffering data for telemetry.
- Solar panels - needs complete development.
- Telemetry - the equipment specifications need to be modified.
- Servers and Analysis Units –specifications of the hardware and software need to be modified.

Next Steps

It was agreed that an additional expert meeting will be needed to continue work on the table in the near future. A finalized list of equipment could also be used as a basis for future purchases of equipment.

EXPERT GROUP SESSION A3: RADIONUCLIDE NOBLE GAS SAMPLING AND MEASUREMENTS

Overview and General Assumptions

Two main technologies discussed by the group were subsurface sampling of noble gases and air measurements of noble gases. The key signature isotopes that would be detected are: Xe-131m, Xe-133, Xe-133m and Ar-37. The goals identified for OSI noble gas measurements are:

- Subsurface noble gas measurements – Primarily to obtain direct confirmatory information regarding whether a nuclear explosion occurred through the measurement of xenon and argon isotopes collected from the subsurface. Under some scenarios, noble gas measurements could be used to help guide further sampling and/or other activities.
- Air sampling of noble gases –To obtain direct confirmatory information regarding whether a nuclear explosion occurred by examination of xenon and argon isotopes collected in the air. The use of mobile noble gas sampling may also be used as wide area survey tool.

General Reactions

The group, which was comprised of only a few noble gas experts, still recognized that noble gas measurement technology, analysis techniques, and identified activities for OSI is relatively new, and there is no commercial equipment available for the needed measurements. This makes the technology specifications a fundamentally different problem than for more mature technologies. It was recognized that there have been substantial improvements in recent years due to experience gained from the IMS and directed noble gas exercises such as NG09. The group also felt that the equipment specifications that were addressed during this workshop should be considered as draft, pending further information that may be gathered in future directed exercises and integrated field exercises.

Views on Content

There was some discussion on how various scenarios might affect noble gas equipment specifications. In summary, it was recognized that there could be significant variations in the needed throughput (samples collected and measured per day) of both of the OSI relevant noble gases which could impact the choice of collection, processing, purification, and measurement equipment. The variation of scenarios could also affect the type of subsurface sampling strategy, e.g. augers or rods needed to penetrate different types of geological materials such as hard rock, alluvium, clay, sand, tundra or permafrost.
Although a range of scenarios are possible for a realistic situation, the goal of the effort was to specify equipment that would be useful in most plausible scenarios, with variability in the number of samples left to be addressed in the number of pieces of equipment or possibly new technology brought to an OSI. In other words, the group used the plans for the best known or planned noble gas equipment as a basis for the discussions, and if it is later decided that more throughput is needed, either multiple pieces of this equipment would be used or new research would have to be completed to meet the eventual need.

The group realized that specifications laid out in previous workshops in the late 1990s are largely obsolete and obviously did not benefit from any of the advances made since that time. Because of this, the Equipment List developed here is significantly more complete and representative of current understanding than the previous work.

Open Issues

A significant unknown regarding noble gas equipment has to do with the right of the ISP (refer to Treaty Protocol, Part II, paragraph 99) to retain portions of samples collected. Views among the group varied from assuming that raw samples must be split at the collection point to samples being required to be split after the measurement was complete (including processing and purification). This issue has equipment ramifications, and final decision from the Preparatory Commission is necessary before the equipment can be further specified.

Due to the extremely new application of noble gas detection to the on-site inspection problem, the relative newness of the technology, and lack of practical exercises, the specifications laid out in this document should be considered preliminary, except where explicitly noted. However, these specifications can be used in conjunction with the on-going program in the PTS to address noble gas measurement for OSI.

Recommendations/Next Steps

The group assumed that recommendations for equipment purchase and integration of such technology will serve as a guide for current needs, and that regular updates to the equipment specifications should be performed as new lessons are learned and new technology and information becomes available. Therefore, the group recommends that the equipment specifications laid out in this document be used as a guideline for future testing of noble gas technology.

EXPERT GROUP SESSION B1: POSITION FINDING AND VISUAL OBSERVATION

Overview and General Assumptions

Overall there were no issues regarding use of Table 2 of TL-4/40 for setting out the equipment specifications for position finding and visual observation, although it was clear that for most, if not all of the equipment items, there would be no need for text on certification and calibration requirements. However, there are issues concerning the level of detail and types of information needed under the “General operational requirements”, “Specific operational requirements” and “Technical specifications” headings. On re-drafting the table in light of the discussions, the EGCLs saw a need to move some text between the columns in the interests of clarity and consistency. This will be an issue to consider for all the completed tables from the workshop sub-groups and in further refinement of the lists. The equipment items in this category appear to be fit for the general OSI purposes for which they are intended to meet.

Views

Group discussions showed that the draft list of equipment was indeed relevant for position finding and visual observation and that most of the proposed additional items from the EGCLs should be retained. LIDAR (Light Detection and Ranging) was readily recognized as a valuable tool for OSI and as such should certainly be included in the Equipment List. However, after discussion participants felt that LIDAR should be more properly considered under the multispectral/infrared (MS/IR) heading rather than in visual observation. The separate entries for binoculars for ground based and aerial observations were dropped and replaced with a combined section. Other items for visual observation such as a planimeter and jeweller’s loupe were added after discussion. In some cases, and as a general point, there is an advantage in having multi-functional items that combine features rather than possessing only a single function. This can save on the numbers of items to be carried by individual inspectors.

Open Issues

Further consideration is required on the specifications for binoculars to separate out more clearly those elements needed for more effective observation of small objects from the air. Some of the items, such as pocket transit compass, should be seen not only as a basic navigation tool, but as part of an individual inspector’s survival kit – an issue that was not further addressed in this workshop. Such a kit would also need to include items such as hard-hats, protective clothing, water bottles etc. The use by the IT of hand-held satellite-based position finding systems on an aircraft remains open and it is not clear whether basic aviation safety considerations would permit this. Two of the additional items agreed – a wind gauge and laser range finding – may also have direct relevance for the RNG sampling and measurements and SAMS requirements. This highlights a general point that some items of equipment support several inspection techniques and requirements and are not specific to any one technique. Specifications may vary, however, so some thought needs to be given to this. For example, although the accuracy requirements for the hand-held satellite based position finding equipment are given as 10 to 20 metres and deemed to be adequate for general positions finding, SAMS may require a greater level of accuracy (up to a few metres) for the central component of the tri-partite array. Some of the requirements, such as the need for light-weight operability in a wide range of climactic conditions and ruggedness, apply for all types of equipment and perhaps need only be specified once or made uniform across all equipment types. This would apply particularly to climactic conditions – temperature and humidity ranges. We may also need to think about whether it is desirable to require military specifications, since these may be too demanding in some cases, resulting in the exclusion of perfectly adequate equipment types or models.

Recommendations

- The revised table (presented in Annex I) should become the new base line for equipment items for position finding and visual observation.
- Specific requirements for a LIDAR system for OSI in the context of MS imaging should be investigated.
- Specifications for the additional equipment items, drawing on commercial off the shelf systems, should be refined.
- Further consideration should be given to development/acquisition for testing purposes of a tablet computer for recording way-points, boundaries and points of interest on topographical or map or three-dimensional model of the inspection area, or be addressed within the context of the Integrated Information Management System (IIMS) and removed from this list.
- The PTS should consider further basic equipment needs for an inspector “survival kit”.
- “Thumb nail” photographs (small photos to serve as a reference icon) of equipment items to be associated with electronic listings should be considered as part of the list.

EXPERT GROUP SESSION B2: MULTISPECTRAL IMAGING AND INFRARED

Overview and General Assumptions

Two background sources of content were used for this session of the workshop. Technical content for the MSIR equipment specification table was developed during the Multi-Spectral Expert Meeting (MSEM-11) in Rome, held from 30 March to 1 April 2011. The starting point for a discussion on updating the MSIR equipment specification was the MSIR specification presented at OSI Workshop-6 (26-30 June 2000, Vienna). While the specifications from OSI Workshop-6 were intended to be draft specifications for MSIR equipment for an OSI, the MSEM-11 developed the specifications for equipment to be used for field tests to mature the MSIR technique. This was done to facilitate the selection and testing of equipment for such field tests, with the expectation that the results of those field tests will be used to further refine MSIR specifications to optimize them for operational use in an OSI.

Views on Content

EGSLs John Henderson and Luis Gaya-Pique set the stage for discussion via presentations reviewing results from MSEM-11 and other recent work. The information from MSEM-11 was reformatted to fit the OPCW-format specification of Table 2 of TL-4/40. Since the information contained in the Workshop-6 format is formatted differently, the EGCLs for this session and participants used the information from the consensus version of the MSEM-11 specification, as well as consensus points and notes from the discussions, to fill in the entries for the table developed for this report. Discussions at MSEM-11 focused on the airborne MSIR equipment, but ground-based MSIR equipment was also considered. The equipment requirements developed at MSEM-11 were for the combined set of airborne and ground-based MSIR equipment. For the considerations of this session, the discussions from MSEM-11 were used as the basis for a separate breakout of the equipment specifications for airborne and ground-based MSIR equipment.

There are three main differences between the content of the Workshop-6 requirements and those considered here:

- Multi-spectral and infrared capabilities will now be considered as two separate instruments (although the spectral instrument may have some infrared capability).
- The thermal infrared capability will be provided by a long-wave infrared (LWIR, 7-14 um) capability rather than by a mid-wave infrared (MWIR, 3-5 um) sensor.
- There is now an explicit specification for ground-based MSIR equipment.

The spectral range identified here will be refined for the operational equipment specifications with the information coming from field tests. In the same way, there is a reference in the table to the availability of a balloon or an elevated platform (type yet to be defined) as auxiliary equipment to obtain better coverage from ground MSIR equipment by elevating it. If we find from the field experiments that either of these pieces of equipment have utility, there will be a need to detail the technical specifications of this equipment, and to describe its use in the OSI operational manual. If this equipment has no value for the technique, they will be deleted from the table.

Open Issues and Gaps

The current specification is adequate for its intended purpose, namely the selection of equipment to be used in MSIR field tests. The gap is a lack of information needed to develop a specification for an operational MSIR instrument for an OSI. The MSIR equipment for aerial measurements has to be flight-qualified and the mechanical deployment procedure (e.g. whether the equipment will be hard-mounted to the aircraft or hand-held) has to be developed. Current practice for airborne MSIR measurements is to use aircraft flight information (global position (GPS); roll, pitch, and yaw; altitude) to geo-register the MSIR data to the ground. All of this information may not be available from the aircraft in an OSI. Field experiments should check whether the expected limited flight information will be sufficient, or if additional on-board instrumentation is needed to collect relevant flight parameters.

There is an open issue about how to survey the entire inspection area in a single additional overflight. Current practice shows that a minimum of three working days may be necessary to cover the inspection area. Two possibilities to address this gap are to use two instruments simultaneously (left- and right-looking sides of the aircraft), or to use an instrument with a wider field of view. During the session on visual observation and position finding (Session B1), the possible use of LIDAR was introduced, and it was suggested that LIDAR probably belonged in the MSIR equipment section. There was not enough expertise on this technique among the participants to the workshop to develop a specification.

Recommendations and Next Steps

The planned MSIR field tests should be carefully planned and executed, with the objective of determining what technical capabilities are needed to detect and distinguish the MSIR observables expected from an underground nuclear explosion. There is currently a PTS MSIR field test planned for September 2011. Lessons identified from the field tests should be used at the next MSIR expert meeting to develop the procedure for deployment of equipment in an aircraft. Depending on the deployment procedure, the selected equipment may need to be flight-qualified. We recommend that a second MSIR expert meeting be held during the Spring of 2012 (MSEM-12). The purpose of this meeting will be to:

- Review and evaluate MSIR field test results.
- Update the MSIR specifications table including auxiliary equipment.
- Start planning the MSIR portion of the PTS field exercise, scheduled for mid 2013, to prepare for IFE14 (CTBT/PTS/INF.1105).
- Use the field data to determine from airborne MSIR data the minimum required flight parameters to analyze the data effectively.
- Discuss options to get full coverage of the inspection area in a single additional overflight.
- Evaluate the utility of an elevated platform or a balloon to elevate the ground MSIR equipment.

This meeting may also be used to discuss the use of LIDAR in the context of an OSI (possibly as a side meeting with LIDAR experts). If the experts decide that this technique is valuable, technical specifications will have to be developed.

EXPERT GROUP SESSION B3: RAPID GAMMA RADIATION SURVEY, RADIONUCLIDE SAMPLING AND HIGH RESOLUTION GAMMA RADIATION

Overview and General Assumptions

Opening presentations in the session were provided by Feng Tiancheng "A Vehicle Mounted NaI Gamma Spectrometer System for OSI" and Chushiro Yonezawa "Radionuclide Analysis at the On-site Laboratory by Gamma-ray Spectrometry and Necessary Equipment for the Analysis", along with an outline for discussion by EGSL Ilijas. The Equipment List for Radionuclide Survey and Analysis (CTBT/PC-7/1/AnnexII App VII part II) was used as a basis for discussion in filling out entries for the Equipment List using the format of Table 2 of TL-4/40. Since a ConOps for radionuclide measurements and environmental sampling has not yet been developed, the group's work on equipment specifications was considered as provisional, based on initial considerations of this workshop. Some of the assumptions and findings agreed to by the group and implicit in the development of the Equipment List given in Annex I are given below:

- The group discussed and decided that the hand portable alpha and beta tool for survey is not practical or required and therefore deleted them from the list.
- Measurements of natural background are essential for gamma spectroscopy to identify gamma anomalies.
- A gamma search tool is divided into three categories: hand held, vehicle borne and air borne. Examples of the types of detectors are specified in the list. Since the ConOps for gamma surveys has not been discussed and documented, details of the detector specifications are subject to further discussion based on a ConOps.
- An *in situ* gamma analysis spectrometer was not listed on the previous list. However, discussions suggested that *in situ* gamma measurements would be important. The technique is also mentioned in the OM text, which is currently under discussion (e.g. CTBT/WGB/TL-18/30). Thus, the group agreed to add the *in situ* gamma analysis spectrometer to the list instead of the limited search tool. Note that development of a ConOps will be an important element for further consideration of this instrument.
- The issue of collection of duplicate samples was touched upon in the session, relative to Treaty Protocol Part II, paragraph 99. For radionuclide samples, which may have short half lives, sample splitting or duplication is a complex issue that impacts the collection and analysis process of an inspection. This issue should be the subject of future expert meetings.

Recommendations, Gaps, and Next Steps

Discussions of radionuclide ConOps are essential to understand the whole scope of field activities to fulfill the inspection mandate. A good understanding of the ConOps will lead to further development of the Equipment List. For the time being, most equipment for environmental sampling is left as "to be determined" (TBD). These items will be determined in the future based on discussions of the ConOps and consideration of sampling strategies and field procedures. Certification criteria and procedures were not discussed and left as TBD.

Certification processes for radionuclide equipment will be complicated and need to be discussed in further expert groups. The certification process of an IMS radionuclide station would be a good starting point for such discussions. It was noted that the OPCW had developed SOPs for sample collection in the field and that the issue of sampling splitting/sharing had been dealt with in this context. It might therefore be worth checking whether there might be any lessons/procedures here that could be appropriate in a CTBT OSI context. The group highly recommended that further discussions be held on the process of identification of anomalies and blinding (referring to measurement restrictions as defined in Treaty Protocol Part II, paragraph 89b) and the list of radionuclides of interest for OSI.

COMMON ELEMENTS

As noted above, Table 2 from CTBT/WGB/TL-4/40 formed the basis for defining the list of equipment. This table, which is based on the Equipment List for the OPCW, has six columns titled “Description”, “General operational requirements”, Specific operational requirements”, “Certification criteria and procedures”, “Technical specifications”, and “Calibration requirements”. The main focus of the work was on the first three columns and the fifth column. The sections of the table dealing with certification criteria (column four) and calibration requirements (column six) were discussed but not filled out by many of the groups because the consensus opinion was that these columns either were not relevant for the technology or it was premature to consider these factors at this time. General use items, such as stationery, chairs, boxes, etc., were not considered. Several groups noted that some items, such as range finding equipment, compass, survival kit, or protective clothing would be of common use for many different inspection activities and could be included in a general “kit” for all inspectors. Another common element noted is a need to specify requirements such as light weight for field use, rugged construction, and uniform climatic conditions as is typically done for military hardware. Finally, all participants recognized and emphasized that the Equipment List of Annex I should be considered as a draft list to be used for further consideration, either by WGB or by subsequent expert groups or workshops.

CLOSING SESSION AND CONCLUDING REMARKS

The closing session began with presentations of the summaries by the EGCLs of the technical sessions (provided above) before the entire workshop group, with short periods of discussion following each presentation. Some of the most notable issues that came up during the discussions were as follows:

- Equipment maintenance in the field is a key consideration and should be included as part of the certification process.
- The right of the ISP to retain portions of samples (Treaty Protocol, Part II, paragraph 99) has an impact on sampling and analysis equipment and needs to be considered further.
- Special equipment may be needed for calibration; this needs to be included and defined in the Equipment List.

In his final comments, the head of the Workshop Organizing Committee, Rozhkov, made reference to IFE14, noting that the PTS will need help from States Signatories to work toward further completion of the OSI Operational Manual and development of the concept of operations for OSI procedures. Shchukin thanked the PTS staff for the excellent support in organizing and running the workshop. Wang noted that the current work on “baselining” the Equipment List is long overdue, so the work of this group has been very important. He noted that the initial period technologies are the essential equipment for an OSI – the “core of the core” equipment. Sateia reiterated that the ConOps is a key element for OSI that needs to be completed. The process of defining specifications – preliminary equipment list – testing – refinement of specifications – refinement of ConOps – with iterations through the loop is an essential part of making sure that the OSI Equipment List is complete and suitable for its purpose. He challenged participants to continue thinking about “technology ConOps” and to continue to make use of the documentation services of the PTS by signing up for the Expert Communication System (ECS).

ACKNOWLEDGEMENTS BY THE RAPPORTEUR

The work of the Rapporteur was greatly facilitated in this workshop by the excellent work done by the EGCLs in producing summaries of each of the technical breakout sessions. The head of the organizing committee and the co-chairpersons provided guidance throughout the workshop to help keep the work focused and guided the format for this report. As has been the case in previous workshops, the hard work of OSI Division Documentation Section (Deng Hongmei, Kevin Stickney, Marie Tweed, Karin Al-Bakir and the rest of the staff) in supporting the writing and production of this report, as well as administrative services during the workshop, is greatly appreciated. The work of this workshop was especially demanding because of the large volume of background material that had to be assembled.

ANNEX I
DRAFT OSI EQUIPMENT LIST FOR INITIAL PERIOD TECHNIQUES

EXPERT GROUP SESSION A1: VIDEO AND STILL PHOTOGRAPHY

Description	General Operational Requirements *(including technique defined)*	Specific Operational Requirements	Certification Criteria and Procedures	Technical Specifications	Calibration Requirements
Part 1. Core equipment for inspection activities and techniques *(Items linked to activities and techniques listed in Paragraph 69, Part II of the Protocol)*					
PP.69(b): Handheld compact digital video camera Cleaning kit, accompanying video processing software: manufacturer's set and accessories as appropriate	• For both ground based and aerial inspection activities	• Simple to Operate. Operable by inspectors in full protective clothes, Ruggedized for most weather conditions, operable between minimum temperature range of -10ºC and +40ºC, relative humidity of 10-90%	*<reference>*	• Screen Size: 2" or higher • Image Stabilization:Yes • Memory Card Type: Removable • Storage Media with rewrite protection • Optical Zoom: minimum range 2x-8x • Digital zoom: minimum 8x • Battery power: provides continuous operation for at least 2 hours • Megapixel: Broadcast quality •Type: Compact • Internal storage: no (this does not refer to the camera's internal buffer) • Satellite Based Navigation System: optional • Storage: Capable of storing at least 2 hours of video at broadcast quality.	N/A

Description	General Operational Requirements *(including technique defined)*	Specific Operational Requirements	Certification Criteria and Procedures	Technical Specifications	Calibration Requirements
PP.69(b). Handheld digital single lens reflex 35mm camera for still photography. Cleaning kit Flash light Tripod Carrying case Cable release Satellite based Navigation System Set. Accompanying Image processing software: manufacturer's set	• For aerial activities and possible higher resolution still photographic images during ground-based inspection activities	• Simple to Operate. • Operable by inspectors in full protective clothes, ruggedized for most weather conditions, operable between minimum temperature range of -10ºC and +40ºC, relative humidity of 10-90%	*<reference>*	• Effective pixels: >12 megapixels • Sensor size: full frame • ISO: minimum range 100-6400 • Image stabilization: yes • Image format: JPEG, RAW, or other standard compressed and uncompressed formats • Focus: auto and manual • Viewfinder coverage: range 90 - 100% • Allow for External flash: yes • Storage type: removable storage media with rewrite protection • Satellite Based Navigation System: optional • Lens: changeable lenses set in [minimum] range 24 to 85mm, • Internal image storage: no (this does not refer to the camera's internal buffer) • Ability to disable any communications device built into the camera (e.g. bluetooth or wifi)	N/A

Description	General Operational Requirements *(including technique defined)*	Specific Operational Requirements	Certification Criteria and Procedures	Technical Specifications	Calibration Requirements
PP.69(b). Handheld compact digital camera for still photography Tripod or monopod: yes Release cable: yes Underwater waterproof case: yes Accompanying Image processing software: manufacturer's set	For ground-based, subsurface, or underwater activities	• Simple to Operate. • Operable by inspectors in full protective clothes, Ruggedized for most weather conditions, operable between minimum temperature range of -10ºC and +40ºC, relative humidity of 10-90%	*<reference>*	• Effective Pixels: minimum 8 megapixels • Sensor size: range 1/1.5-1/1.7 • ISO: Auto, minimum range 80-1600 • Image stabilization: optional • Image format: JPEG, RAW or other standard compressed and uncompressed formats • Lens focal length: minimum range 28-140 mm • Digital zoom: yes • Manual focus: yes • Remote control: optional • Built-in flash: optional • Allow for External flash connection: yes • Satellite Based Navigation System: optional • Voice Recording for Annotation: Optional • Storage media: removable storage media with rewrite protection • Internal image storage: no (this does not refer to the camera's internal buffer) • Battery power: provides continuous operation for at least 2 hours	**N/A**

EXPERT GROUP SESSION A2: SEISMIC AFTERSHOCK MONITORING SYSTEM

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Part 1. Core and auxiliary equipment for inspection activities and techniques *(items linked to activities and techniques listed in paragraph 69, Part II of the Protocol)*					
69(e) Passive seismological monitoring for aftershocks					
SAMS (entire system level)	Protocol, Para 69(e) Model text OM 6.5.1	Detect, localize and characterize aftershocks with M>= -2 with the signal in the frequency band 1-100 Hz, and be capable of being maintained in the field conditions	Need to be developed	Field equipment (Number of mini-arrays should not be less than 50 as indicated in the Table A1.3-1 in the model text of OM) and data center equipment	none
Field equipment (main system level)	Protocol, Para 69(e) Model text OM 6.5.1	Model text OM A1.3.5-9 using the Chapter 10 including data transmission with the possibility of using the telemetry equipment	Certification criteria and procedures on data quality, timelines, availability and authentication need to be developed having in mind functionality and limitations on capability	Number of mini-arrays should not be less than 50 as indicated in the Table A1.3-1 in the model text of OM	Channel based calibration Model text OM Para A1.3.3 and 4
Digitizers	Record in digital format seismic waveform data measured in the field	Capable to digitize signals from seismometers, add authentication signature to the data, store them on recording media and provide to telemetry equipment in	Need to be developed	• Modularity**:** For easy upgrade and maintenance Portability: Rugged, compact packaging capable of operation in weather extremes. Maximum dimension approximately • 0.5 metre. Maximum weight approximately *2 kg* • Power consumption**:** Low power consumption (approximately 5 W or less *for use of 6 channels by 500sps)*	In accordance with manufacturer requirements

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
		environmental conditions (conditions need to be defined)		• *Gain: Possibility to select several gains.* • Power voltage**:** *9-16 V DC* • *Grounding specification:* *Needs to be defined* • Dynamic range**:** Dynamic range 96 dB or better (*24* bit or better A/D) *LSB***:** • Sampling rates: Capable of sampling at *500 Hz* or greater on six or more channels. • Filtering: Compatible anti-aliasing filters • Trigger algorithms**:** Reliable detection algorithms for various types of events • Data storage option**:** for at *least 2 days of continuous data* • Data compression**:** Desirable to compress data prior to telemetry or storage • Data format**:** *CSS, sac, GCF, miniSEED, or SEED* • Telemetry options **:** Compatible with a wide range of telemetry designs • GPS**:** GPS based timing either transmitted from master or internal system • Environmental: Operating temperatures from –40ºC to +50°C • Display console**:** Integral with graphical review • ***Authentication capability:*** *needs to be defined* • *Buffering all data for* telemetry**:** needs to be defined Source: PTS/INF.856 with modifications (italics)	
Recording media	Store seismic waveform data, state of health and meta data in digital form	Capable to store for a minimum of 2 days waveform data, state of health and meta data	Need to be developed	2GB or bigger	none

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
		from the digitizer			
Seismometers 3C with the installation kits	Measure ground motion in the field	Capable to measure ground motion and provide to digitizer in appropriate frequency band and in environmental conditions (conditions need to be defined)	Need to be developed	3 component, short period, single package, rugged and compact *(<20* cm on side, ~8 kg). Minimum-frequency bandwidth: approximately 1 Hz to 40 or 50 Hz Velocity sensor: 2 Hz corner frequency acceptable Needs to be relatively insensitive to levelling errors Minimum sensitivity to ground motion: *400* V•s•m^{-1} at damping of 0.64 **Environmental conditions:** Operating temperatures from –40ºC to +50°C (needs to be re-examined) ***Power voltage:*** *9-16 V DC* Source: PTS/INF.856 with modifications (italics)	In accordance with manufacturer requirements
Seismometers 1component with the installation kits	Measure ground motion in the field	Capable to measure ground motion and provide to digitizer in appropriate frequency band and in environmental conditions (conditions need to be defined)	• Need to be developed	Vertical component. Otherwise the same specifications as for 3C seismometers	In accordance with manufacturer requirements
Accessories	Provide interconnection between equipment in order to create functional seismic stations or mini-arrays	Capable to connect seismometers, with digitizers, provide the electric power, connect digitizer to the telemetry and set-up GPS receiver or antenna (if external)	• Need to be developed	• *At least 10 m of armoured and shielded cables with connectors from 3-C seismometer to data logger* • *At least 100 m of armoured and shielded cables with connectors and drum from 1-C seismometer to data break-out box and logger* • RS3232, RS422, PCMCIA modem, Ethernet 10BaseT/100BaseT Wireless LAN cables *with connectors* • Power supply cables *with connector* to the digitizer *and clips* to the battery • Break-out boxes to combine and connect the 3	none

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
				single component seismometers to the digitizer • Shielded RJ45 crossover cable *with connectors* to connect digitizer. • *In case of external GPS or GPS antenna, cable with connectors between GPS and digitizer* • Source: PTS/INF.856 with modifications (italics)	
Batteries	Need to be developed	Need to be developed	Need to be developed	• 12V •Sufficient for 2 weeks of operations given the power requirements of the seismic station *or mini-arrays* •Sufficient capacity to operate *seismic station or mini-array* for *72 hours at extreme conditions* *(need to define normal and extreme conditions)* Source: PC 7/1/ Annex2 with modification (italics)	none
Distance meters	Need to be developed	Need to be developed	Need to be developed	At least 100m with accuracy 1%	none
Compasses	Need to be developed	Need to be developed	Need to be developed	1deg accuracy	none
Digging tools	Need to be developed	Need to be developed	Need to be developed	Appropriate for installation of seismometers	none
Solar panels	Need to be developed	Need to fit with battery specs	Need to be developed	Need to be developed	none
Telemetry equipment	Need to be developed	Portable, modular ready-set-up system, at both field stations and data center site which allows selection of data	Need to be developed	• Telemetry Antenna Towers to be modular for easy set-up. • Digital telemetry system for continuous data communication between the seismic stations and the data center, with the longest	none

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
		transmission frequency compatible with national and international regulations (UHF/VHF or Spread Spectrum). Needs to be configured for a network to avoid interference between radios be connected to the digitizer		transmission leg being 30 km line-of-sight. • All Stations should be capable of continuous data transmission to the data center site at sample rates appropriate for the vertical and three component seismometer sensors. • Equipment must allow bi-directional communication, *full duplex*. • Telemetry elements should be operable with low power consumption – need less than 5 watt, made available by using batteries, generators (thermo-electric or solar power). Suitable options should be indicated. • Outdoor operations between temperature ranges of *–40*°C to +50°C. with minimal interference from weather and cultural noise sources. • Relay stations between each leg and central station as deployment of this may be necessary under some conditions . • *The telemetry should also allow transmission of the state of health parameters.* • *Various topologies of the telemetric network should be possible.* • *Frequency plan should take into account variability in seismic station or mini-array distribution.* • *Emitted energy should be specified.* • Source: PTS/INF.201 with modifications (italics) • Need to be modified	
Data center equipment (main system level)	Need to be developed	Need to be developed	Certification criteria and procedures on data quality, availability and authentication	Need to be developed	Need to be developed

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
			need to be developed having in mind functionality and limitations on capability		
Servers and Analysis units	Need to be developed	Central data acquisition, and processing (visualisation, interpretation and analysis system), should be carried out on a minimum of *two servers and 8 analysis units* for acquisition, review and database management and for processing and display. Software should use data formats capable of fulfilling the overall objectives. Format specifications and programmes/subroutines for reading and writing must be included with software. All in depth analysis and assessment need to be accomplished in the field in near-real-time and the proposed system should account for this requirement. The requirement for back-ups and production of duplicates of all archival	Need to be developed	Power Requirement: • All hardware, as appropriate, should be operable using different mains voltage available internationally *including 220V AC 50 Hz.* Power conditioning features *are essential.* • Computer Hardware Package *1. A minimum of two servers, for acquisition, review and database management and for processing waveforms* and display are required. System should be modular, capable of easy periodic upgrades to improve system capability, eliminate unavailable components and streamline maintenance. UNIX or Windows operating system. 2. *Central processing hardware should be able to support and receive continuous incoming digital signals*. Data integrity is an important factor – ability to incorporate reliable, encryption and authentication of data during transmission is an important factor. Able to send authenticated commands to remote stations is also a requirement. On-line/Off-line Seismic Data Processor Workstations/ PC's and LAN (e.g. Ethernet) Capability. Enhanced Keyboards and 3 bottom Mouse XVGA monitors (1200+horizontal) Storage Media (Configured as a disk array RAID *at least* level 1); Duplicates on suitable archival medium such as CD-ROMs or DVD-ROMS. A minimum "historic" data	Need to be developed

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
		databases and products is essential. Where appropriate, inclusion of removable hard-disks is an essential requirement. The proposal should take account of these generic factors in determining the compatible LAN configuration for computer hardware (e.g Ethernet) and software operating systems (UNIX or Windows). ***Note:*** The ability to examine and, as appropriate, modify the packages for unwanted features is also a prime requirement. PTS/INF.201 Annex I with modifications (italics)		storage capacity of *60* days operation is required (*3 TB* or greater on-line). 3. Either computer of entire operation in case of partial failure. 4. Parallel capability for downloading data of non-telemetered remote stations from hard disk should be provided. 5. Hardware/Software package should be capable of supporting all acquisition from a mix of single component and three component sensors at field-stations. 6. All data, results and operations have to be backed up to sufficient mass storage devices automatically. 7. Colour printer for documentation. Peripherals and modems etc. as required to support system operation. • Software for Acquisition, Storage, Processing, Interpretation, and Visualisation • Minimum Requirements • The software package(s) should be capable of supporting multiple functions for appropriate data visualization, interpretation, analysis and assessment. The overall software system should have capability to carry-out: • Operator Interface Package • System configuration of *seismic* stations. Setting and displaying current parameters via telemetry 1.1. Data re-request capability (as appropriate), 1.2. *Seismic* station SOH/*mini*-array SOH 1.3. Maintaining system, activity quality assurance and	

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
				alarms for exceptional conditions or failure. 1.4. All relevant operations by operators need to be logged to provide an audit trail: 1.5. Robust operation and resistant to crashes. 1.6. All data and operations are stored automatically in a database on mass storage with automatic, periodic backups to archival medium such as duplicate CD-ROMs. 1.7. Database of events and any continuous data with query tools for extracting information and its management. 1.8. Operation with different types of telemetry as appropriate Overall System Requirement • The *data center* should also have capability to carry out the following functions, at the request of an operator and optionally with automatic features, as appropriate: • Data Acquisition & Management Package • Ability to merge real-time acquisition with later data • Merge data physically transported on a mass storage media. • Database, data archiving, data management and query tools. • All relevant operations by operators need to be logged to provide an audit trail. • Processing and Analysis Package • Processing capabilities with determination of seismic source parameters that are dependent upon both	

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
				frequency and waveform characteristics. • Determination of type and quality of waveforms • Determination of ground motion characteristics P and S wave arrival time picking • Source location (include options for different location methods for events inside and outside the network. These include processing of small 3 and 4 element arrays, L1 and L2 norms for minimisation and /or other methods suitable for automated processing. • Seismic source parameter determination (magnitude, spectra, corner frequency, moment, apparent stress, stress drop, energy released, etc.) • Calculate average velocities of P and S waves from a cluster of seismic events to different *seismic* stations. • All relevant operations by operators need to be logged to provide an audit trail. Options for: Flagging events with different characteristics. (e.g. ability to distinguish between seismic v/s cultural noise) using expert systems. Notify analyst/operator of events or groups of events that fit specific profiles based on source characteristics, (e.g. emergent or regular, low or high frequency, mine explosions or natural events, etc.) Visualisation and Interpretation Package Options for: Interactive or pre-set displays of quantitative parameters. *Event Display* – in space and time by their magnitude, energy, moment etc.	

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
				Data Selection: Selection by time period, ranges of seismic parameter values, etc. *Contouring:* describe a seismic event in 3D. Views: orthographic or perspective, three dimensional rotation, moving or static. Seismic-ray tracing in complex geologic medium and joint hypocentral event location and velocity inversion for refining locations and solving for station delays. Tomographic analysis to localise areas of seismic wave attenuation PTS/INF.201 Annex I With modifications (italics) Needs to be modified Need to define data flow and processing time for a daily volume of data	

SESSION A3: RADIOACTIVE NOBLE GAS SAMPLING AND MEASUREMENTS

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Radio Xenon Purification and measurement System – System of modular components that automatically separates Xenon from air collected in bottles, transfers it into a nuclear detector system, measures the activity concentration of ^{131m}Xe, ^{133}Xe, ^{133m}Xe	• The System shall separate and purify xenon from bulk gas samples. • The System shall provide Xe gas purification function, which purifies Xe samples from radon (Rn), carbon dioxide (CO_2), methane, water vapor and other impurity gases. • The System shall measure the volume of stable xenon in the sample with an uncertainty of better than 10% with one sigma confidence. • The final MDC of the system for ^{133}Xe- and for ^{131m}Xe needs to be determined based on a 1 m^3 sample processed and counted in one day, respectively, based on a background measurement. • Also other technical details will be determined. • Other Radioxenon isotopes can be detected and used to discriminate other sources, such as	• The System shall be capable to archive purified gas samples into archive container(s). • The System shall record State of Health data sufficiently frequently to document all relevant process values. State of Health data relevant to a sample shall be available after processing for quality and maintenance purposes. Status and location of the sample must be maintained during the whole process. Commands shall be logged as appropriate. • The System will interface to Preprocessing (sample mixing and splitting) unit(s). More technical details TBD. • The System shall provide modular concept processing units with possibility to further expansion in order to increase throughput or sample processing. • Provide an exhaust output from the xenon purification process (after other impurities removal) for external argon purification unit(s). • The throughput of this system shall be at least four	• Will follow IMS procedures	• The purification factor of radon from air shall be better than 10^{-6} and will be TBD in detail later. • Collection efficiency of xenon gas shall be better than 70% (collection efficiency is defined as the ratio of xenon in the detector cell divided by xenon in the sample fed into the system) - TBD • Cross contamination as defined in INF 921 between samples shall not be more than 1%. • The equipment shall have four detectors fulfilling the technical requirements. • The equipment shall be possible to analyze four or more samples (TBD)	The System shall employ scientific methods to assure quality measurements, such as frequent calibrations and background measurements.

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
	^{135}Xe;	samples per 8 hours.			
^{37}Ar Processing, Purification and measurement System – System of modular components that automatically separates Argon from air collected in bottles, transfers it into a nuclear detector system, measures the activity concentration of ^{37}Ar	• The System shall separate and purify Argon from bulk gas samples. • The System shall provide Ar gas purification function, which purifies Ar samples from radon (Rn), carbon dioxide (CO_2), methane, water vapor and other impurity gases. • The System shall measure the volume of stable Argon in the sample with an uncertainty of better than 10% with one sigma confidence. • The System shall produce an MDC for ^{37}Ar of no more than 4 mBq/SCM, based on a background mea-surement. • More details will be determined. • Sampling rate 10 L/min, Sampling Volume $0.2m^3$,Yield of Argon 70%	• The System shall be capable to archive purified gas samples into archive container(s). • The System shall record State of Health data sufficiently frequently to document all relevant process values. State of Health data relevant to a sample shall be available after processing for quality and maintenance purposes. Status and location of the sample must be maintained during the whole process. Commands shall be logged as appropriate. • The System will interface to Preprocessing (sample mixing and splitting) unit(s). More technical details TBD. • The System shall provide modular concept processing units with possibility to further expansion in order to increase throughput or sample processing. • The throughput of this system shall be at least four samples per 8 hours.		• Power supply: 220V, 50Hz, 5kW; Consumable needed for equipment – Liquid Nitrogen: 100 L per workday; Helium: purity greater than 99.99%, 300 L per workday; Nitrogen: purity greater than 99.99%, 50 L per workday; Methane: purity greater than 99.99%, 2 L per workday • Shield: For low-level counting of samples, shielding the detector to reduce ambient background radiation is essential. Many materials are used in shield designs, lead being the most common because of its high atomic number and density. In the measuring system, the lead shield that is located outside the anti-detector is adopted to decrease the background in the proportional counter. The thickness of the shielding wall is 4 cm and the total weight of the shield and its bracket shall be around 250 kilogram. • Maximum power 5kW Consumption of liquid nitrogen 30L Consumption of carrier gas 50L but more details will be determined • The equipment shall be possible to analyze four samples per day (TBD)	The System shall employ scientific methods to assure quality measurements, such as frequent calibrations and background measurements.
Workstation	Self contained workstation with analysis software for NG Data – the software	12 GB RAM storage, more technical details TBD	TBD, because NG systems are		N/A

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
	with the following functions: Monitoring of real-time systems functions, analysis of raw spectrum data, analysis of system status of health, analysis of calibration & background data.		still under development		
Workstation	Self contained workstation with analysis software for local ATM TBD later	12 GB RAM storage, more technical details TBD			N/A
Pumping System	High pressure air compressor unit for collecting subsurface & bulk air	Oil less, Phase separator, HEPA filter, flow controller as tamper indicator, flow totalize also as tamper indicator, Logging system, electric motor driven, Pressure relief valve,	To be derived from standardized commercial Scuba systems	Variable between 1 to 100 l per min flow rate, max. operation pressure 250 At / 3600 PSI, minimized footprint	Derived from commercial systems
Tank, Containers	High pressure gas containers to collect air/soil gas samples	Max. operating pressure 250 At / 3600 PSI, container shall provide possibility for identification tags / bar coding and tamper indication	Pressure-resistance 1.5 times the operating pressure, to be derived from standardized Scuba systems	Volume 10 l,	N/A
Augering equipment	Self propelled platform with auger equipment to allow the preparation of soil gas sampling points	200 drilling m per 12 hours in medium consolidated sediments, percussion drill head to allow destruction of boulders or hardened layers up to 1 m, The system shall be capable to	N/A	To be derived from the 2011 October experiment in Stupava/Slovakia	TBD

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
		operate on slopes with up to 20% dipping angle;			
Liquid Nitrogen Generator	Production rate 60 l per 24 hours producing liquid nitrogen		TBD	TBD	N/A
Field Lab BoO	Facility for sample preparation and analysis, with A/C, heating, reliable UPS power supply, tool storage,	Temperature stability range – 40 degrees to +50 degrees	N/A	TBD	TBD
Oscilloscope	four channel digital unit with back-up software to be used for system set-up & debugging and internal signal tracing	TBD	TBD	TBD	TBD
Carrier Gas Set	Gases needed for the operation of the purification / measurement & analysis systems	System is comprised of multiple gases automatic bottle switching equipment	TBD	Pressure relief valves & regulators and oxygen displacement alarm following relevant ISO standards	TBD
Standard Gas for RNG system calibration and operation	Ar, Xe, Co_2, SF_6	Purity for standard gases shall follow the specific requirements of the RNG systems	TBD	TBD	TBD
Radioactive Standard Sources	Radioactive sources traceable to International Standards for calibration check of nuclear detectors	Radioactive sources such as ^{137}Cs, ^{55}Fe, ^{133}Ba or appropriate multi-line sources	Appropriate international traceability	Uncertainty of ± 10% of activity	N/A
Satellite Position Finding	System to determine the geo-referenced location of the sampling points, shall be commercial off the shelf product	Accuracy 1 m	Following manufactures conditittions	Shall follow the PTS standard for the visual observation kit to ease operation & training	N/A
Portable Generators	Fuel driven standard generators following PTS			Following ISO standards	N/A

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
	standards				
Packers	Air-Pressured packers to seal the augered sampling holes against surface air	Standard off-the shelves product	N/A	To be determined after Stupava exercise in Autumn 2011 after augering equipment is selected	N/A
Sample Hose Kit	Variation of different hoses, sealing and auxiliaries to connect the sampling spot with the compressor / air pump and sample containers			Following ISO standards	N/A
Sample ID kit Tamper Proof ID kit	Identification / seals for sampling tracking and integrity to establish the chain of custody	IAEA type ID/seals are envisaged	TBD following IAEA standard	following IAEA standard	N/A
Tarps	Material to cover the vicinity of the augered sampling hole to avoid surface air to mix with the pumped soil gas	Commercially available off the shelf (COTS)		TBD	N/A
Tracer Monitors	Equipment to determine the amount of atmospheric infiltration into subsurface sample	SF_6 detection system at sub PPM levels; ^{222}Rn detector at kBq m^{-3}, CO_2 at +100 ppm ; TBD	Following manufactures specification	TBD	Following manufactures instruction
Mass Flow controller	Equipment for controlling and measuring the flow rate into the pressurized containers	Maintain and document flowrate into the pressurized containers at 1 to 100 l min^{-1} up to 250 At / 3600 PSI with an accuracy better $\pm$ 10 % , TBD	Following manufactures instruction	Following ISO standards	Following manufactures instruction
Hot Sample Screening Unit	System to rapidly screen field samples to avoid damage to subsequent RNG measurement systems	TBD	TBD	TBD	TBD

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Mixing & Splitting Device	A device made to with defined proportionality mix multiple field samples into one single sample. This single sample will analyzed by the RNG systems,	Includes splitting device to allow for field sample splitting for archives and for ISP request for duplicated sample [1]		Following ISO standards	TBD
E log Book	Comprehensive system to log all relevant information associated with one sample to assure chain of custody;	COTS			N/A
Hazardous Material Storage	Cage to secure store hazardous material during field operation	COTS			N/A
Tamper Proof Cage	Lockable space to store samples collected in the field	Size of cage will be determined after Concept of Operation have been approved by WGB; Tamper indicator and seals are part of the initial design	N/A	TBD	N/A
A 3 Printer	Printing device as Standard lab equipment connected to the two workstations (Analysis, ATM)	Standard printing device following principal PTS standards of Computer Items			N/A
Digital Meteorological Station with Satellite based geo-referencing and satellite based time stamping	Station to collect relevant raw data to ensure a modeling of the local atmospheric transport model within the inspection area	COTS			TBD
Shielded Container	Container for check	COTS			N/A

[1] Needs attention from WGB which will affect final system specifications;

Description	General operational requirements *(including technique-defined)*	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
	sources				

EXPERT GROUP SESSION B1: POSITION FINDING AND VISUAL OBSERVATION

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Part 1. Core equipment for inspection activities and techniques *(Items linked to activities and techniques listed in paragraph 69, Part II of the Protocol)*					
69 (a) Equipment for position finding					
Hand held satellite based position finding device	• Have sufficient accuracy to establish location as required by the Treaty, • Be able to function without reference to maps or visual markers. • Be capable of checking and clearing the memory upon completing the inspection. • Together with antenna, has to be portable. • Suitable for ground use. • Not require operator calibration. Meet international and State Party requirements for safe packaging and transport. • Be operable by one person	• Hand held, portable. • Functional in all geographical areas, temperatures ranging from winter to tropical climates and at high and low altitudes • Batteries adequate for at least 12 hours of continuous operation. • Downloaded mapping - optional. • Compatible with other OSI techniques requirements. • In transport configuration, be rugged enough to withstand rigors of transport by aircraft and vehicles. • Capable of operation with either an internal or external antenna except where required for aircraft safety (to the unit, not to the aircraft).	None	• Minimum horizontal location accuracy of 0.10 to 20 metres Visual display and computer-compatible output for downloading internally-recorded way points after returning to BOO. • Capable of recording date/time/location at a set interval (< 1 minute) or on a mark. • Capable of recording minimum 50 to 1000 way points (record date and time along with location and elevation in meters). • Must be capable of taking an initial reading within 15 minutes of unpacking. • Accessories to include car kit – adapter and car mount and carrying case	None

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Magnetic compass	• Capable of use in Northern and Southern hemispheres and underground. • 0 to 360^o readings compass with magnetic damping.	• Waterproof • High impact case for durability. • Luminous points for night navigation. • Ruggedized/robust housing.	None	• Built-in adjustable magnetic declination. • Must have accuracy within 1 degree from true course. • The numerals marked in 1 or 2 degree increments. • Must have a large sighting mirror. • Must be equipped with an inclinometer for slope angle measurements. • Preferably equipped with built-in battery lighting unit or battery illumination for night navigation. • Parallax free glass lens magnification (10x) or better. Sighting system in an Anti-static liquid filled for optimal dampening of the sightmeter card. • Max +-0.5° from true magnetic course with precision sighting. • Max +-1.0° from true magnetic course with direct reading. • Light weight: 60 – 200 grams)	None
Hand held Altimeter	• Capable of determining altitude of location in the inspection area for ground based measurements	• Operating temperatures at least from -10 to +40^o C.	None	• Barometric pressure with temperature compensation. • At least be capable of determining the altitude from - 800 to 10000 m ranges with barometric pressure from 790 and 553 millimeters Hg. Handheld, portable. • Resolution < 10 m. • Error Limit < 10 m. • Weight < 120 grams without battery(s) (if applicable).	None
Pocket transit compass	• Light weight with 0 to 360^o reading compass	• Splash-proof. High impact case for durability. Lightweight. • Transparent ruggedized body Map-measuring scales in mm or inches.	None	• Built-in adjustable magnetic declination. • Must have accuracy within 1 degree from bearing. • Silicon rubber feet for precision map work, • Detachable safety-release lanyards, • Night-enabling luminous markings. • Magnifying lens. • Map-measuring scales in mm or inches, 1:25,000, 1:50,000. • Built-in adjusters for magnetic declination (including permanent local adjustment). • Clinometer for measuring slope angle, and 45-degree angle assistance on the mirror-sighting function.	None

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Hand-held laser/optical range-finding equipment	• Usable for long distance shooting. • Simple operation when operatives wearing protective clothing. • Invisible/eye safe laser. • Auto/manual shut-off. • Low power consumption. • Must be operable during the day or at night. • Indication of mis-measurement. • Operable in all weather conditions, with a waterproof body.	• Weight of less than 1.2 kg including battery(s), carrying case and any other accessories. • Resistant to shocks and jolts. • Splash proof. Preferably equipped with audio/visual indicators of error display (for optical back-up lower standards are acceptable).	None	• Capable of range-measurement of at least 1000 m. • Five times optical zoom for sighting. • Short range suppression to less than 50 m. • Range accuracy of 1 metre or better. • Range resolution approximately 1 metre. • Measuring accuracy approximately + 1 m at 1000 m, with measuring time of <1 second. • Battery(s) power source must be sufficient for at least 1000 individual measurements or at least up to 12 hours of use.	To be determined.
69 (a) Equipment for visual observation					

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Binoculars suitable for ground or aerial use	• Suitable for visual observation/survey from the air, at and below the surface to search for anomalies and artefacts. • Suitable eyepieces/protection for use on aerial platforms • Passive Night vision capabilities	• Accessories to include carrying case and neck strap. • Laser range finder in-built. • Satellite referencing.	None	• Minimum power of 6 x. • Actual field-of-view: 4 – 5 degrees. • Diameter of the objective lens: 20 – 50 mm. • Wide-field-of-view: 8 –9 degrees. • Minimum eye relief of 12 mm. • Eye-width adjustment range: 60 mm. • Anti-reflection coated optical component. • Weight of less than 1.5 kg. • Diameter of the objective lens of the binoculars must be at least 50 mm, giving a field of view of approximately 120 m at 1000 m. • Must be operable in all weather conditions. • Must be protected with water-proof and shock-proof armour covering/coating. • Weight of less than 2 kg. • Accessories: consist of carrying case and neck strap. • Image stabilised	None
Stereoscopic microscopes	•Petrographic/metallurgical scopes capable of identification and characterisation of soil/rock samples and anomalies for use in Boo.		None	• Classification : for small laboratory uses • Magnification: > 30 x. • Built-in illumination. • Polarising light source. • Must be operable in wide range of climates. • Must be protected with a water-proof and shock-proof armor covering/coating. • Accessories: consist of carrying case, microscopic slides and microscopic slide maker. • Teaching head. • Object marker, drawing tube, dark-field ring unit, polarizing filter set for transmitted light.	None

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Magnifying glass	• Ground-based field observation/survey	• The lens must be supplied with an appropriate cover or, if plastic, the lens must be hard-coated to prevent scratches	None	• Magnification of the lens must be more than 5x, with a lens diameter of 4 – 8 cm. • 2.5" Focal Distance • 36.0 mm lens diameter • Number of lenses: 1 and/or 2	None
Stereoscope (Analogue and Digital)	• To allow viewing of all types printed or computer displayed stereo images.	• Durable for field use and BOO use,.	None	• ABS frames. • Stainless steel legs. Interpupillary adjustment from 55 to 75 mm. Durable protective sleeve. • Image is magnified 1.2 x by eyepiece. • Crown glass lenses. Surface coated long lasting chrome mirrors.	None
Hand lens or jewellers' loupe	• For closer examination of soils/rock samples to assist geological profiling of inspection area		None	• More than 6 x magnification. • Multi-element optics and metal frame 1 to 2 cm diameter	None
Hand-held stereoscopic magnifying glass	• Ground-based field observation/survey for stereoscopic viewing of images • Separate items required for field and BOO use (portable/fixed)	• Magnification of the lens must be 10x, and 30x, with lens diameter of 4-8 cm**.** Differential requirements for field and BOO use • Triple element. • Light weight for field use. • The lens must be supplied with an appropriate cover or, if plastic, the lens must be hard-coated to prevent scratches.	None	• Fixed magnification. • Adjustable spacing. • Self-contained light source Fixed plate for mounting images.	None

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Wind gauge and altimeter	• For wind speed, barometric pressure and altitude in mountainous areas	Memory for 24 hour history	None	• Winds speed • Wind chill • Barometer • Altitude • Temperature (Celsius and Fahrenheit) and clock timer	None
Digital map measurer	• Ready calculation of distances/route lengths on maps		None	• Waterproof design. • Variable settings according to map scale. • Measures planned routes in kilometers, miles or nautical miles. • With known speed able to calculate how long needed to cover the rest of the trip.	None
Analog map measurer			None	Pointer Eight map scales between 1:15.000 and 1:750.000	None
Digital Planimeter	• Measuring function: area line side length(s)		None	• Measuring scales: mm, cm, m, km, in, ft, acre, yd. • Measuring range: 300 x 10 m. • Accuracy: ±0.1%. • Battery life: 20 hours use. • Weight: <700 grams.	None
Total station (intelligent Theodolite)	• Accurate and rapid field surveying and mapping to facilitate orientation in IA.	• Carrying out both angular and linear measurements with their processing in field conditions.	None ?	• Accuracy of 0.5 angular seconds and 2 millimeters + 2 mm/km. • Range of action - up to 5 kilometres.	Temperature and humidly factors to be taken into account
Geologists' hammers	• For safe collection of a diverse range of rock type samples			• 0.5 kg pick (one-end pointed) • 1.25 kg sledge (both ends flat)	
Part 2. Auxiliary equipment necessary for the effective and timely conduct of on-site inspection					
Ranging poles for marking or scaling purposes and areas of H&S concern			None	• Two-metre- red and white hashed. Aluminium for durability and ease of decontamination. • One pointed steel tip. • Multi—section poles in two one metre sections.	None
Marking tape for			None	• Fluorescent (and range of colours)	None

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
marking or indicating boundaries or areas of interest					
Tablet Computer[2]	• For recording way-points, boundaries and points of interest on topographical map/model of Inspection Area. • Long battery life – minimum three hours.	• Readily decontaminated.	TBD	• 3 D presentation of terrain. • "Fly-over" at variable altitudes and viewing angles. • Separate software. • Light weight and compact. • Protective carrying case.	TBD
Water proof notepads/universal waterproof markers/drafting tools			None		None
Night vision scope			None		None
Digital Dictaphone for recording details of observables	• Long life battery for up to 12 hours continuous use. • Large memory.		None		None
Map cases		• Readily decontaminated.	None	• Flexible in temperatures down to -20C • Water proof and readily None decontaminated • A4 paper, A3 and larger. None • To include folded maps.	None
Walking poles					
Survey rod (Jacob's staff)			None	• 1.5 meter length • 1 cm graduations pocket transit mount Weight less than 0.5 kg	None

[2] This could also be addressed within the context of the IIMS and therefore removed as a discrete item from this list.

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
Measuring tapes/ruler		• Readily decontaminated	None	• 100 meter length • 50 meter length • 5 meter length • Depth gauge (• Metal/wood ruler 30 cm • Aviation plotter	None

EXPERT GROUP SESSION B2: MULTISPECTRAL IMAGING AND INFRARED

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
1 Protocol, Part II, Par.69b Multi-spectral imaging	• To reduce the search area by looking for anomalies on an additional overflight • Capable of being deployed on a wide range of aircraft, either fixed wing or rotary	• Ruggedized for most weather conditions • Preferable to use aircraft power [may be certification issues if use aircraft power], needs to be able to use batteries if necessary • Cooled detector: electronic cooling OK (no cryogens should be required for cooling) • Flight altitude of 1500 m preferred, minimum acceptable altitude of TBD	N/A	• Spectral range: 0.3 to 2.5 µm with multiple channels (partial coverage of the whole range) • Dynamic range: 12 bit or greater • Imaging mode: compatible with aerial operation with OSI flight parameters • Ability to accept auxiliary data such as satellite navigation and aircraft flight information • Gain/exposure control: camera exposure can be set in-flight, and it is guided by the scene emittance level to achieve maximum levels of dynamic range • Spatial resolution: 2 mrad or better (the spatial scale of thermal anomalies is not 100% known yet) • Integrated field of view: ± 45-60 degrees to be revised • Operable between temperature range of -10°C to +40°C • Operable within relative humidity of 10% to 90%	• Ability to be easily maintained and calibrated in the field • Radiometric calibration • Spectral calibration • Geometric calibration • Optical alignment to the IR sensor

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
2 Protocol, Part II, Par.69b Infrared imaging measurements	• To reduce the search area by looking for thermal anomalies on an additional overflight • Capable of being deployed on a wide range of aircraft, either fixed wing or rotary	• Ruggedized for most weather conditions • Preferable to use aircraft power [may be certification issues if use aircraft power], needs to be able to use batteries if necessary • Cooled detector: electronic cooling OK (no cryogens should be required for cooling) • Flight altitude of 1500 m preferred, minimum acceptable altitude of TBD	N/A	• Spectral range: 7-14 µm (no need for mid-wavelength IR) • Dynamic range: 12 bit or greater • Imaging mode: compatible with aerial operation with OSI flight parameters • Ability to accept auxiliary data such as satellite navigation and aircraft flight information • Gain/exposure control: camera exposure can be set in-flight, and it is guided by the scene emittance level to achieve maximum levels of dynamic range • Spatial resolution: 2 mrad or better (the spatial scale of thermal anomalies is not 100% known yet) • Integrated field of view: ± 45-60 degrees (TBR) • Operable between temperature range of -10°C to +40°C • Operable within relative humidity of 10% to 90%	• Ability to be easily maintained and calibrated in the field • Radiometric calibration • Thermal calibration • Geometric calibration • Optical alignment to the multi-spectral sensor
3 Protocol, Part II, Par.69b Support equipment for multi-spectral and infrared imaging	• To support collection of multi-spectral and infrared data on an additional overflight	• Ruggedized for most weather conditions • Preferable to use aircraft power [may be certification issues if use aircraft power], needs to be able to use batteries if necessary	N/A	• Pilot display indicator to assist the pilot in maintaining flight course and image acquisition control • In-flight control for following the planned flight (satellite navigation system) • Equipment to mount to aircraft/helicopter • Calibration equipment (radiometric, spectral, geometric, and alignment) •In-flight computer, software and display •BOO analysis computer (and displays) and software (probably part of the inspection team information management system) • Operable between temperature range of -10°C to +40°C • Operable within relative humidity of 10% to 90%	N/A

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
4 Protocol, Part II, Par.69b Multi-spectral imaging	• To reduce the search area by looking for anomalies from ground-based and below the surface measurements • Capable of being deployed on a wide range of vehicles or by personnel	• Ruggedized for most weather conditions • Compatible with use of vehicle power, generator, or batteries • Cooled detector: electronic cooling OK (no cryogens should be required for cooling)	N/A	• Spectral range: 0.3 to 2.5 µm with multiple channels (partial coverage of the whole range) • Dynamic range: 12 bit or greater • Imaging mode: snapshot imaging • Ability to accept auxiliary data such as position and pointing information • Gain/exposure control: camera exposure can be set, and it is guided by the scene emittance level to achieve maximum levels of dynamic range • Spatial resolution: 2 mrad or better (the spatial scale of thermal anomalies is not 100% known yet) • Integrated field of view: N/A • Operable between temperature range of -10°C to +40°C • Operable within relative humidity of 10% to 90%	• Ability to be easily maintained and calibrated in the field • Radiometric calibration • Spectral calibration • Geometric calibration • Optical alignment to the IR sensor
5 Protocol, Part II, Par.69b Infrared imaging measurements	• To reduce the search area by looking for anomalies from ground-based and below the surface measurements • Capable of being deployed on a wide range of vehicles or by personnel	• Ruggedized for most weather conditions • Compatible with use of vehicle power, generator, or batteries • Cooled detector: electronic cooling OK (no cryogens should be required for cooling)	N/A	• Spectral range: 7-14 µm (no need for mid-wavelength IR) • Dynamic range: 12 bit or greater • Imaging mode: snapshot imaging • Ability to accept auxiliary data, such as position and pointing information • Gain/exposure control: camera exposure can be set, and it is guided by the scene emittance level to achieve maximum levels of dynamic range • Spatial resolution: 2 mrad or better (the spatial scale of thermal anomalies is not 100% known yet) • Integrated field of view: N/A • Operable between temperature range of -10°C to +40°C • Operable within relative humidity of 10% to 90%	• Ability to be easily maintained and calibrated in the field • Radiometric calibration • Thermal calibration • Geometric calibration • Optical alignment to the multi-spectral sensor

Description	General operational requirements	Specific operational requirements	Certification criteria and procedures	Technical specifications	Calibration requirements
6 Protocol, Part II, Par.69b Support equipment for multi-spectral and infrared imaging	• To support collection of multi-spectral and Infrared data on ground-based measurements	• Ruggedized for most weather conditions • Compatible with use of vehicle power, generator, or batteries	N/A	• Compass and inclinometer for azimuth and elevation information for analysis of ground data • Satellite navigation system for location information • Tripod and/or vehicle-mounting capability • Calibration equipment (radiometric, spectral, geometric, and alignment) • In-field computer, software and display • BOO analysis computer (and displays) and software (probably part of the inspection team information management system) • Possible request for cherry picker or tethered balloon to deploy the instruments above the ground • Operable between temperature range of -10°C t0 +40°C • Operable within relative humidity of 10% to 90%	• N/A

EXPERT GROUP SESSION B3: RAPID GAMMA RADIATION SURVEY, RADIONUCLIDE SAMPLING AND HIGH RESOLUTION GAMMA RADIATION MEASUREMENTS

Description	General operation requirement	Specific operational requirement	Certification criteria and procedures	Technical specifications	Calibration requirements
Part 1 Core equipment for inspection activities and techniques					
69 (c) Equipment for radioactivity level measurements					
Objective: using gamma radiation analysis to search for and identify radiation anomalies at surface					
Handheld					
Hand portable gamma search tool	Handheld equipment to measure the gamma radiation on surface to identify OSI relevant radionuclides	• Handheld size equipment • Maximum total weight less than 10kg • Battery powered, >8hr operation • Operation temp -30 – 50deg C, humidity up to 95% • Ruggedized, water proof • Built in satellite based positioning system	TBD	The gamma scanning equipment shall meet both sensitivity requirements and operational requirement in Box 2. Following is an example of recommended specifications but not limits the possible specifications. Other detectors, such as CZT, HPGe are also acceptable in some cases. • NaI(Tl) 2” or larger • Energy range 25keV-3MeV • Energy resolution <8% @137Cs • MCA : 256 ch or better	• Energy calibration • Efficiency calibration • By using check sources, 60Co, 137Cs
Vehicle portable					

Description	General operation requirement	Specific operational requirement	Certification criteria and procedures	Technical specifications	Calibration requirements
Vehicle portable gamma search tool	Vehicle portable equipment to measure the gamma radiation on surface to identify OSI relevant radionuclides	• Maximum total weight and size:TBD (see comment) • Battery powered, >8hr operation • Operation temp -30 – 50deg C, humidity up to 95% • Ruggdized, • Built in satellite based positioning system Details of vehicle shall be discussed in conjunction with search equipment specifications. Field vehicles such as off road type vehicles or snowmobiles shall be also considered. Operational requirement will be suggested by the specifications of the vehicles accordingly.	TBD	The gamma scanning equipment shall meet both sensitivity requirements and operational requirement in Box 2. Following is an example of recommended specifications but not limits the possible specifications. Other detectors, such as CZT, HPGe are also acceptable in some cases. • NaI(Tl) 16 liter or larger • Energy range 25keV-3MeV • Energy resolution <8% @137Cs • MCA : 256 ch or better	• Energy calibration • Efficiency calibration • By using check sources
Air borne					

Description	General operation requirement	Specific operational requirement	Certification criteria and procedures	Technical specifications	Calibration requirements
Air borne gamma search tool	Air borne portable equipment to measure the gamma radiation to identify OSI relevant radionuclides	• Total size fit to aircraft, i.e. <1m3 • Maximum total weight :TBD • • Battery powered, >8hr operation • Operation temp -30 – 50deg C, humidity up to 95% • Ruggedized, water proof • Built in satellite based positioning system	TBD	The gamma scanning equipment shall meet both sensitivity requirements and operational requirement in Box 2. Following is an example of recommended specifications but not limits the possible specifications. Other detectors, such as CZT, HPGe are also acceptable in some cases. • NaI(Tl) (large volume, at least 16 liter) • Energy range 25keV-3MeV • Energy resolution <8% @137Cs • MCA : 256 ch or better	• Energy calibration • Efficiency calibration • By using check sources
In situ gamma measurement					

Description	General operation requirement	Specific operational requirement	Certification criteria and procedures	Technical specifications	Calibration requirements
In- situ High resolution gamma spectrometer for field	High resolution gamma spectroscopy in the field to identify OSI relevant radionuclides	• Maximum total weight TBD • Battery powered, >8hr operation • Operation temp -30 – 50deg C, humidity up to 95% • Ruggedized, water proof	TBD	• HPGe (ideally 100% relative efficiency or larger) • Energy range 25keV-3MeV • Energy resolution <2.5keV @60Co • MCA : 1024 ch or better • Characteristics of crystal for numerical efficiency calculation Reporting or analysis of natural background is essential for gamma spectroscopy. Further discussions on “information barrier” issues are highly recommended.	• Energy calibration • Efficiency calibration • By using check sources,
69 (d) Environmental sampling and analysis (solids and liquids)					

Description	General operation requirement	Specific operational requirement	Certification criteria and procedures	Technical specifications	Calibration requirements
Stationary, high resolution gamma Spectrometer (p-type: coaxial)	High resolution gamma spectroscopy for environmental samples to identify OSI relevant radionuclides	• Operation temp 10– 30deg C, humidity up to 95% • Ruggedized crystal mount and vacuum • Weight less than 25kg (detector) • Electrical cooled	TBD	• P-type (coaxial) HPGe detector 50% efficiency or larger • Energy resolution : <2keV @60Co • Characteristics of crystal for numerical efficiency calculation • MCA: 1024 ch or better • shield: 10cm thick Pb with Cd, Cu • shield weight approx 1 ton • shield shall be designed for easy transportation Reporting or analysis of natural background is essential for gamma spectroscopy. Further discussions on “information barrier” issues are highly recommended.	• Point sources for energy calibration • Volume sources for efficiency calibration - Silicon resin matrix - International standard mixed gamma emitters - Identical shapes with measurement sample containers, air filters

Description	General operation requirement	Specific operational requirement	Certification criteria and procedures	Technical specifications	Calibration requirements
Stationary, high resolution gamma Spectrometer (n type broad energy)	High resolution gamma spectroscopy for environmental samples to identify OSI relevant radionuclides	• Operation temp 10– 30deg C, humidity up to 95% • Ruggedized crystal mount and vacuum • Weight less than 25kg (detector) • Electrical cooled	same above	• Broad energy HPGe detector 50% efficiency or larger • Energy resolution : <0.7keV @122keV • Characteristics of crystal for numerical efficiency calculation • MCA: 1024 ch or better shield: 10cm thick Pb with Cd, Cu • shield weight approx 1 ton • shield shall be designed for easy transportation. Reporting or analysis of natural background is essential for gamma spectroscopy. Further discussions on "information barrier" issues are highly recommended.	• Point sources for energy calibration: • Volume sources for efficiency calibration - Silicon resin matrix - International standard mixed gamma emitters - Identical shapes with measurement sample containers, air filters
Low resolution gamma counter for screening	Quick screening will be performed before sampler preparation to determine the high resolution measurement condition	• Operation temp 10– 30deg C, humidity up to 95%	TBD	• NaI (Tl) 8" or larger • Energy resolution <6% @ 137Cs • Associated lead shielding which fits sample containers • MCA 512ch	• Energy calibration • Efficiency calibration
Part 2 Auxiliary equipment necessary for the effective and timely conduct of on site inspections					
69 (c) Equipment for radioactivity level measurements					
LN2 generator	Provide liquid nitrogen for core equipment		N/A		

Description	General operation requirement	Specific operational requirement	Certification criteria and procedures	Technical specifications	Calibration requirements
Tripod	Locate in situ germanium detector at proper position in the field for measurements		N/A		
69 (d) Environmental sampling and analysis (solids and liquids)					
Soil sampling kit	Take soil samples for gamma spectroscopy analysis		N/A	TBD	N/A
Liquid sampling kit	Take samples for gamma spectroscopy analysis		N/A	TBD	N/A
Vegetation sampling kit	Take vegetation samples for gamma spectroscopy analysis		N/A	TBD	N/A
Sampling preparation kit @lab	Process environmental samples for gamma spectroscopy analysis.		N/A	TBD	N/A
Air (filter) sampler	Take air dust (particulate) samples for gamma spectroscopy analysis		N/A	TBD	N/A
Portable weather station	Collect weather information, i.e. weather direction and speed, to be fed into ATM analysis		N/A		N/A
Set of sample containers	Contain environmental samples to fit detector systems for gamma spectroscopy analysis		N/A	• Cylindrical container, i.e.B70,B87, PD236 • Marinelli beaker, i.e.MB450, MB13 • Plastic bag (ziplok ?) for air filters	N/A

ANNEX II

LIST OF SUPPORTING MATERIALS

I. Plenary Sessions: OSI Equipment List

II. Session A: Expert Group Meetings
A1: Video and still photography A2: SAMS A3: RNG sampling and measurements

III. Session B: Expert Group Meetings
B1: Position finding and visual observation B2: Multispectral imaging and infrared B3: Rapid gamma radiation survey, radionuclide sampling and high resolution gamma radiation measurements

I	Plenary Session: OSI Equipment List	Doc Symbol	Year of Issue	Title
	WGB Documents	CTBT/WGB-7/US/3	1998	Functional Performance Requirements for On-Site Inspection (OSI) Equipment
		CTBT/PC/III/WGB/TL/60 Rev.1	1997	Initial Requirements for Procurement of OSI Equipment and for Logistics
	INF Papers	CTBT/PTS/INF.709	2004	Initial Illustrative List of OSI Equipment and Specifications for Testing and Training Purposes and Use During Field Experiment 2007
		CTBT/PTS/INF.328	2000	Obligating Authority for OSI Technical Equipment
		CTBT/PTS/INF.183 Add.1	1999	OSI Equipment: Operational requirements, performance and technical specifications for visual, sampling, communications, health and safety and support equipment items
		CTBT/PTS/INF.76/Rev.1	1999	Procurement Procedures for On-Site Inspection

				Equipment Items
	Task Leader Proposals	CTBT/WGB/TL-4/40	2011	List of Equipment for Use During On-Site Inspection
		CTBT/WGB/TL-4/7/Rev.2	1998	OSI Task Leader Paper – Initial Equipment List for Training and Testing Purposes and Indicative Specifications
		CTBT/WGB-6/TL-4/2	1998	OSI Task Leader Paper: Draft initial equipment list for training and testing purposes and indicative specifications
		CTBT/WGB-6/TL-4/5	1998	Draft Initial Equipment List for Training and Testing Purposes and Indicative Specifications
	Presentations By Experts At Past OSI Workshops	CTBT/WS/OSI-18/PR/21	2010	V. Shchukin: Development of the list of OSI equipment
		CTBT/WS/OSI-18/PR/08	2010	R. Arndt, M. Melamud: Preparation of the list of OSI equipment for approval by the first Conference of States Parties
		CTBT/WS/OSI-18/PR/09	2010	JIA Mingyan: Consideration on the OSI Equipment List
		CTBT/WS/OSI-18/PR/10	2010	B. Milbrath: OSI Equipment List (with some focus on radionuclide/noble gas)
		CTBT/WS/OSI-18/PR/11	2010	J. Walker: OPCW and approved equipment issues
		WS-6 PR/4	2000	Mr. Albert Smith: OSI Equipment Specifications and Operational Procedures: A Summary of Workshops
		WS-5 PR/29	1999	Mr. Albert Smith: Equipment Lists and Specifications Logistics Requirements
		WS-3 PR/8	1998	Dr. Steven Lewis: Measurement Restriction Requirements for OSI Equipment and Software
		WS-2 PR/14	1998	Dr. Yuri Sakharov: Initial Survey of Inspection Area: Requirements to Equipment at Limitation of Operations
		WS-2 PR/19	1998	Dr. Alwyn Davies: Equipment to be Used in Initial and Later Overflights
		WS-2 PR/20	1998	Dr. Li Hua; Initial List of Partial OSI Equipment and Specifications
		WS-2 PR/27	1998	Mr. Daniel Brand: Considerations for Selecting

				Initial Overflight Equipment
		WS-1 CTBT/PC/III/OSI/WS/SL/3/Rev.1	1997	Mr. C. Antoine: Initial Survey of Inspected Area
		WS-1 CTBT/PC/III/OSI/WS/PR/10	1997	Dr. Y. Sakharov: Initial Survey Methods (Including Overflights and Locations). Subject: Initial Survey of Inspected Area
	Workshop Reports	CTBT/WS/OSI-18/1	2011	

II	**Expert Group A1: Video & Still Photography**	**Doc Symbol**	**Year of Issue**	**Title**
	WGB Documents	CTBT/WGB-29/1	2007	
		CTBT/WGB-17/1	2002	
		CTBT/WGB-12/1 CTBT/PC-12/1/Annex II	2000	
	INF Papers	CTBT/PTS/INF.897	2007	Still Digital Photo Cameras
		CTBT/PTS/INF.865	2007	Digital Cameras for Still and Video Photography
		CTBT/PTS/INF.438	2001	Modification to Specifications of Hand-held Video Camera (Consumer-Grade) for On-Site Inspections
		CTBT/PTS/INF.258/Rev.2	2000	On-Site Equipment: Operational Requirements and Performance and Technical Specifications for Still Photography, Video Photography, Visual Observation and Position-Finding Equipment Items
		CTBT/PTS/INF.183 Add.1	1999	OSI Equipment: Operational requirements, performance and technical specifications for visual, sampling, communications, health and safety and support equipment items
	Task Leader Proposals	CTBT/WGB/TL-4/36/Rev.1	2006	Technical Specifications of OSI Equipment for Still Photography: Possible Update
	Presentations By Experts At Past OSI Workshops	CTBT/WS/OSI-18/PR/19	2010	R. Arndt, C. Kaltseis: Handling of digital images and experience from forensic works
		WS-5 PR/15	1999	Mr. Gerard Essertel: Visual Observation Support
		WS-5 PR/13	1999	Mr. Paul Rockett: A Helicopter-based Demonstration of Hand-Held Photography for a CTBT OSI Overflight

	Workshop Reports	CTBT/WS/OSI-18/1	2011	

II	Expert Group A2: Seismic Aftershock Monitoring	Doc Symbol	Year of Issue	Title
	WGB Documents	CTBT/WGB-12/CRP.3	2000	
		CTBT/PC/V/WGB/US/10	1998	
		CTBT/WGB-7/1 CTBT/PC-7/1 Annex II	1998	
	INF Papers	CTBT/PTS/INF.856	2006	Final Specifications for the Upgrade of the Passive Seismic Monitoring System
		CTBT/PTS/INF.329	2000	Deployment and Operation of the Seismic Aftershock Monitoring System (SAMS) Near Vienna
		CTBT/PTS/INF.311	2000	OSI Passive Seismic Equipment Testing Programme: Initial Objectives and Criteria for Phases A and B
		CTBT/PTS/INF.201	1999	OSI Equipment: Final procurement specifications for passive seismic equipment
	Task Leader Proposals	CTBT/WGB-6/TL-4/2	1998	OSI Task Leader Paper: Draft initial Equipment List for training and testing purposes and indicative specifications
	Presentations By Experts At Past OSI Workshops	CTBT/OSI/WS-17/PR/20	2010	P. Labak: Contribution to IT Operationalization: Status of the SAMS and its Future Development in the Light of OSI Methodology
		CTBT/OSI/WS-16/PR/05	2009	Mr. P. Labak: SAMS Technique and Equipment: Current Status and Future Development
		CTBT/OSI/WS-16/PR/24	2009	Mr. J. Sweeney: Seismic Detection: Passive and Active
		CTBT/OSI/WS-10/PR/32	2004	Dr. Frederico Guendel: SAMS System Data Acquisition and Analysis Strategy Built on an Oracle Relational Database and Geotool: The Pipeline Approach
		CTBT/OSI/WS-10/PR/36	2004	Mr. Mario Takeya: The Methodology on OSI Seismic Monitoring System

		CTBT/OSI/WS-8/PR/25	2002	Gideon LEONARD: A Novel Approach for Design & Data Processing for a Passive Seismic Survey
		WS-4 PR/15	1999	Dr. Yuri Kaplan: Technology of Passive Seismic Monitoring for Aftershocks at Later Periods of OSI
		WS-3 PR/15	1998	Dr. Albert Smith: Analysis for Passive Seismic Monitoring During an OSI: Methods and Software
		WS-2 PR/24	1998	Dr. Albert Smith: Application of Aftershock Monitoring to an OSI: Equipment Specifications, Procedures and Operations (Paper: Application of Passive Seismometry to an OSI: Equipment Specifications)
		WS-2 PR/25	1998	Dr. Albert Smith: Equipment Specifications, Procedures and Operations (Paper: Application of Passive Seismometry to an OSI: Equipment Specifications)
		WS-2 PR/26	1998	Mr. Rodolfo Console: Mobile Seismic Monitoring for Aftershocks
		WS-2 PR/31	1998	Dr. Claude Antoine: Specifications of an Aftershocks Monitoring System Designed for Site Monitoring, Including OSI
		WS-1 CTBT/PC/III/OSI/WS/SL/4	1997	Mr. A. Smith: Passive Seismometry
		WS-1 CTBT/PC/III/OSI/WS/PR/2	1997	Dr. Z. Li Xing: OSI Technique: Aftershock Monitoring. Subject: Passive Seismometry
		WS-1 CTBT/PC/III/OSI/WS/PR/12	1997	Mr. C. Antoine: CTBT-OSI Some Proposals for Aftershocks Monitoring Specification. Subject: Passive Seismometry
		WS-1 CTBT/PC/III/OSI/WS/PR/13	1997	Dr. Y. Sakharov: Passive Seismic Survey. Subject: Passive Seismometry
	Other Relevant Technical Documents	TR/2001-1	2001	Passive Seismic Aftershock Monitoring System Testing Programme: Phase A Testing
		CTBT/WGB/TL-18/44 - Chapter 6.5 - Annex 1.3	2010	

II	Expert Group A3: RNG Sampling & Measurements	Doc Symbol	Year of Issue	Title
	WGB Documents	CTBT/PC-22/1/Annex II, Recommendation 4	2004	
		WGB-23/AT/1	2004	
		CTBT/PC-19/1/Annex II, App IV	2002	
		CTBT/WGB-9/US/1	1999	
		CTBT/WGB-9/1	1999	
	INF Papers	CTBT/PTS/INF.1088	2010	2009 On-Site Inspection Noble Gas Field Operation Tests (NG09)
		CTBT/PTS/INF.1054	2010	Report on OSI Noble Field Operations Tests 2009 (NG09)
		CTBT/PTS/INF.929	2008	OSI Equipment for Xenon Sampling, Separation and Measurement: Plan for Further Development and Testing
		CTBT/PTS/INF.898	2007	Status of the Noble Gas Measurement Technique and PTS Plans to move Noble Gas Systems to Test Operations
		CTBT/PTS/INF.857	2006	OSI Equipment for Xenon Sampling, Separation and Measurement: Execution and Conclusion of Testing Programme
		CTBT/PTS/INF.674	2004	Report on Initial Demonstration of Movable Argon-37 Rapid Detection System (MARDS)
		CTBT/PTS/INF.639	2004	OSI Equipment For Xenon Sampling, Separation and Measurement: Plan for Obtaining the Equipment and Cost Implications for Major Programme 4
		CTBT/PTS/INF.472	2002	Initial Feasibility Study on Radioactive Xenon Detection Equipment for On-site Inspection Testing and Training Purposes
		CTBT/PTS/INF.578	2003	Detailed Technical Specifications and Requirements for the Development of On-Site Inspection Equipment for Xenon Sampling, Separation and Measurement

		CTBT/PTS/INF.561	2002	OSI Equipment for Xenon Sampling, Separation and Measurement: Feasibility Study
		CTBT/PTS/INF.88	1999	PTS Proposals of Detailed Specifications for Radionuclide Survey and Analysis Equipment
	Task Leader Proposals	CTBT/WGB/TL-4/15/Rev.1	1999	Equipment for Xenon sampling, separation and measurement. Suggestion on refining specifications
		CTBT/WGB/TL-4/10	1999	Refining Specifications for Radionuclide Survey and Analysis Equipment
	Presentations By Experts At Past OSI Workshops	CTBT/OSI/WS-17/PR/07	2010	J. Sweeney, C. Carrigan: Some Ideas Regarding Concepts of Operations for CPT and Noble Gas Sampling for OSI
		CTBT/OSI/WS-17/PR/10	2010	P. Li: Some Thoughts on the Research and Development of OSI Radioactive Noble Gas Equipment
		CTBT/OSI/WS-17/PR/11	2010	C. Carrigan: NG09 and CTBT OSI Noble Gas Sampling and Analysis Requirements
		CTBT/OSI/WS-17/PR/26	2010	H. Miley et al: OSI Noble Gas Concepts of Operations
		CTBT/OSI/WS-17/PR/29	2010	Y. Dubasov: Mobile High Productivity Installation for Xenon Radionuclide Analysis
		CTBT/OSI/WS-17/PR/23	2010	X. Han: Radionuclide Measurement Techniques for OSI
		CTBT/OSI/WS-16/PR/06	2009	Mr. J. Tanaka: Radionuclide Equipment: Current and Future
		CTBT/OSI/WS-16/PR/20	2009	Mr. T. Bowyer: Noble Gas Sampling for OSI
		CTBT/OSI/WS-16/PR/33	2009	Mr. Zhang Yulong: Comment on Ar-37 System
		CTBT/OSI/WS-11/PR/24	2005	Mr. Paul Saey: Recent Developments on Noble Gas Analysis and Reviewing Software for OSI Purposes
		CTBT/OSI/WS-10/PR/45	2004	Dr. Martina Schwaiger: Radionuclide Equipment for OSI
		CTBT/OSI/WS-10/PR/41	2004	Dr. Li Hua: An Overview of Development and Demonstration of Radioactive Noble Gas Measurement Equipment for OSI

CTBT/OSI/WS-10/PR/40	2004	Mr. Jian Gong: The Demonstration and Performance of Movable 37 Ar Rapid Detection System (MARDS)
CTBT/OSI/WS-9/PR/28	2003	Dr. Yuri V. Dubasov: Development of radioactive noble gases sampling and measurement system for OSI
CTBT/OSI/WS-9/PR/32	2003	Dr. Yuri Povov: Development and preliminary testing of some OSI equipment units for Xe radionuclides measurement
CTBT/OSI/WS-8/PR/8	2002	Y.S. POPOV, Y.V. DUBASOV: Development of Some Units of Small-size Equipment for OSI Xenon Radionuclide Detection
CTBT/OSI/WS-8/PR/9	2002	Z. BIAN, W. LI, R. DUAN, H. WANG, M. HE: Movable 37Ar Rapid Detection System (MARDS) for the OSI
CTBT/OSI/WS-8/PR/10	2002	LI Hua: Noble Gases Measurements and Operational Procedures
CTBT/OSI/WS-8/PR/11	2002	HAN Dongmei: Noble Gases Leakage During UNE and Its Sampling and Analysis
CTBT/OSI/WS-8/PR/12	2002	Anders RINGBOM: An OSI-System for Sampling and Measurement of Radioxenon
CTBT/OSI/WS-8/PR/15	2002	Bob ANDREWS: Feasibility Study for OSI Equipment for Xenon Sampling, Separation and Measurement: A Progress Report
CTBT/OSI/WS-7/3	2001	Yuri V. DUBASOV: Radioactive Xe Sampling and Measurements Technology for OSI
CTBT/OSI/WS-7/15	2001	DUAN Rongliang: 37Ar Measurement and Analysis and the In-Field Monitoring System for OSI
CTBT/OSI/WS-7/20	2001	Guy BRACHET: Xenon Analysis
CTBT/OSI/WS-7/22	2001	Anders AXELSSON: Possibilities for Utilising the SAUNA Radio-Xenon Monitoring Concept for OSI Purposes
CTBT/OSI/WS-7/24	2001	Yuri POPOV: Modified System of Sub-Soil, Measurement of Radioactive Xenon for OSI

		WS-6 PR/15	2000	Mr. Yuri Popov: Automatic Portable Radiometer of Isotopes Xe ARIX-02 in Atmospheric Air and Subsoil Gas for On-Site Inspection
		WS-5 PR/5	1999	Mr. Yuri Popov: The Use of Portable Noble Gas Analyzer for Determination of Radioactive Xenon Isotopes in Soil Gas for On-Site Inspection
		WS-2 PR/23	1998	Dr. Yuri Dubasov: Instrumental Complex "BRIG" and its Potentialities for OSI
	Other Relevant Technical Documents	TR/2011-1	2011	2009 OSI Noble Gas Field Operations Tests (NG09)
		TR/2007-1	2007	Development, Demonstration, Testing and Evaluation of OSI Equipment for Xenon Sampling, Separation and Measurement

III	Expert Group B1: Position Finding & Visual Observation	Doc Symbol	Year of Issue	Title
	WGB Documents	CTBT/WGB-12/1 CTBT/PC-12/1/Annex II	2000	
	INF Papers	CTBT/PTS/INF.1113	2011	2010 Tabletop Exercise in the Use of Visual Observation Techniques During an On-Site Inspection
		CTBT/PTS/INF.258/Rev.2	2000	On-Site Equipment: Operational Requirements and Performance and Technical Specifications for Still Photography, Video Photography, Visual Observation and Position-Finding Equipment Items
		CTBT/PTS/INF.183 Add.1	1999	OSI Equipment: Operational requirements, performance and technical specifications for visual, sampling, communications, health and safety and support equipment items
	Presentations By Experts At Past OSI Workshops	CTBT/OSI/WS-16/PR/16	2009	Mr. B. Ludwig: Visual Observation from Overflights
		CTBT/OSI/WS-16/PR/27	2009	Mr. F. Kuang: A Practical Strategy for Visual Observation
		CTBT/OSI/WS-10/PR/30 CTBT/OSI/WS-10/PR/37	2004	Mr. Bing Gong: Application of Position Finding Techniques During an OSI
		WS-4 PR/24	1999	Dr. Yuri Sakharov: Analysis of Various Strategies in Conducting Visual Observations in an Inspected Region: The Experience of Table-top Exercise
		WS-2 PR/16	1998	Mr. Ward Hawkins: Ground-Based Visual Observation Activities and Data Management: Equipment for the Initial Survey of the Inspection Area
		WS-1 CTBT/PC/III/OSI/WS/PR/5	1997	Mr. W. Hawkins: Ground-Based Visual Inspection for CTBT Verification. Subject: Initial Survey of Inspected Area
	Workshop Reports	CTBT/WS/OSI-6/1	2000	Appendix A: 4. AOF – Aerial Location
	Other Relevant Technical Documents	LA-13244-MS	1996/ 1997	Hawkins and Wohletz: Visual Inspection for CTBT Verification

		Lessons Learned from DE10-GBVO	2011	Lessons Learned from DE10 (extract from DE10 Technical Report draft)

III	Expert Group B2: Multi-Spectral Imaging/Infrared	Doc Symbol	Year of Issue	Title
	Presentations By Experts At Past OSI Workshops	CTBT/OSI/WS-17/PR/28	2010	M. Chiappini: The Multi (hyper) Spectral Component of the OSI Verification Systems
		WS-5 PR/12	1999	Mr. Paul Rockett: Multi-spectral Imaging in a CTBT OSI (Utility, Definition and Specification)
	Other Relevant Technical Documents	MSEM_11_LLNL	2011	J. Henderson: Multi-Spectral and Infrared Imaging For On-Site Inspections

III	Expert Group B3: Gamma Radiation Survey, Radionuclide Sampling, High Resolution Gamma Radiation Measurements	Doc Symbol	Year of Issue	Title
	WGB Documents	CTBT/PC-11/1 Annex II CTBT/WGB-11/1	2000	
		CTBT/WGB-9/PTS/CRP.3	1999	
		CTBT/PC-10/1 Annex II CTBT/WGB-10/1	1999	
		CTBT/PC-8/1 Annex II CTBT/WGB-8/1	1999	
		CTBT/WGB-6/UA/1	1998	
	INF Papers	CTBT/PTS/INF.778	2005	Final Procurement Specifications for Radionuclide Survey and

				Analysis Equipment for On-Site Inspection: High Resolution Gamma Spectrometer Tool for Field Or Laboratory Use for Testing and Training Purposes
		CTBT/PTS/INF.710	2004	Technical Terms of Reference for the Procurement of High Resolution Gamma Spectrometer Tool for Field or Laboratory Use for Testing and Training Purposes
		CTBT/PTS/INF.508	2002	Concepts for Implementing the Testing and Evaluation of OSI Radionuclide Survey and Analysis Equipment: Hand-Portable Gamma Search and Limited Gamma Identification Tool
		CTBT/PTS/INF.298	2000	Procurement of High Resolution Gamma Spectrometer Tool for Field or Laboratory Use: Current Status
		CTBT/PTS/INF.295	2000	Final Procurement Specifications for Radionuclide Survey and Analysis Equipment for On-Site Inspection: Hand-Portable Gamma Search Tool for Testing Purposes
		CTBT/PTS/INF.224	1999	Final Procurement Specifications for Radionuclide Survey And Analysis Equipment for On-site Inspection: Hand- and Vehicle-portable Gamma Search And Limited Identification Tools for Testing and Training Purposes
		CTBT/PTS/INF.183 CTBT/PTS/INF.183/Add.1	1999	OSI Equipment: Operational requirements, performance and technical specifications for visual, sampling, communications, health and safety and support equipment items
		CTBT/PTS/INF.168	1999	OSI equipment: Draft Commercial Terms of Reference and Concept for Procurement of Radionuclide Survey and Analysis Equipment
		CTBT/PTS/INF.163	1999	OSI equipment: procurement specifications for radionuclide survey and analysis equipment for testing and training purposes
		CTBT/PTS/INF.88	1999	PTS Proposals of Detailed Specifications for Radionuclide Survey and Analysis Equipment
	Task Leader Proposals	CTBT/WGB/TL-4/10	1999	Refining Specifications for Radionuclide Survey and Analysis Equipment
	Presentations By Experts At Past OSI Workshops	CTBT/OSI/WS-16/PR/25	2009	Ms. A. Dougan: Radiation Detection Technologies for On-Site Inspection
		CTBT/OSI/WS-16/PR/21	2009	Mr. B. Milbrath: Radionuclide Sampling and Detection

CTBT/OSI/WS-11/PR/06	2005	Mr. Wolfango Plastino: OSI Environmental Sampling: Methodological and Instrumental Developments
CTBT/OSI/WS-11/PR/11	2005	Mr. Steve Lewis: Field Experience Gained with the Handheld FIELDSPEC Gamma Monitoring Tool
CTBT/OSI/WS-11/PR/19	2005	Mr. Vikram Patel: Overview and Status of Radionuclide Equipment
CTBT/OSI/WS-11/PR/25	2005	Mr. Malcolm Cooper: Overview of Gamma Survey for the Initial Inspection Using Aerial and Ground-Based Equipment
CTBT/OSI/WS-11/PR/26	2005	Mr. Malcolm Cooper: Sample Analysis: Concepts and Experience
CTBT/OSI/WS-9/PR/30	2003	Dr. Andrey Dubina: On one approach to the development of gamma-spectrometer for OSI purposes
CTBT/OSI/WS-9/PR/38	2003	Dr. Vikram Patel: OSI equipment issues: towards the concept of hardware independent software
WS-5 PR/25	1999	Mr. Christian Bourgeois: Requirements and Methodology for the Measurement of Radioactivity Using an Airborne/Carborne Gamma Radiation Monitoring System
WS-5 PR/26	1999	Mr. Guy Brachet: The Contribution of the Gamma Spectroscope to the CTBT
WS-4 PR/18	1999	Dr. Ingolf Winkelmann: The German Capability for Environmental Airborne Gamma-Ray Spectrometry
WS-3 PR/14	1998	Dr. Steven Kreek: Initial Recommendations for Restricting Gamma-Ray Spectrometry Measurements of Radionuclides for OSI
WS-3 PR/20	1998	Dr. Nikolai Ivashkin: Possibilities of Equipment and Software "Blinding" for Gamma-Radiation Monitoring and Spectrometric Analysis of Ecological Samples
WS-3 PR/33	1998	Dr. Xu: Application of Radionuclide Measurement
WS-3 PR/34	1998	Mr. Mikka Nikkinen: Blanking and Gamma-Ray Spectrometric OSI Measurements
WS-2 PR/11	1998	Dr. Wolfgang Rosenstock: A Transportable System for Radioactivity Measurements In-Situ
WS-2 PR/18	1998	Mr. Gordon MacLeod: Radionuclide Survey and Safety Equipment Needed for CTBT/OSI
WS-2 PR/21	1998	Dr. Yuri Dubasov: Basic Requirements to Instruments and

				Equipment Used to Conduct Radiation Measurements for OSI
		WS-2 PR/22	1998	Dr. Ferdinand Steger: Rapid In-Site Determination of Environmental Radioactivity by HP-Germanium Detector
		WS-2 PR/29	1998	Dr. Steve Kreek: Radionuclide Sampling, Sample Handling and Analytical Laboratory Equipment for CTBT/OSI
		WS-2 PR/33	1998	Dr. Nikolai Ivashkin: Basic Technical Requirements and Specifications on the Equipment for Detection of Gas Anomaly of Underground Nuclear Explosion
		WS-2 PR/34	1998	Dr. Claude Antoine: Specifications of Carbon Gamma-Ray and Field Laboratories for OSI
		WS-1 CTBT/PC/III/OSI/WS/SL/5	1997	Dr. N. Ivashkin: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/11	1997	Mr. G. MacLeod : Radionuclide Measurements during the Initial Phase of a CTBT OSI. Subject: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/15	1997	Mr. G. Brachet: Helinuc: Operational Gamma Monitoring Tool from Helicopter as Potential Contracted Tool for OSI. Subject: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/15/Add.1	1997	Mr. G. Brachet: Airborne Gamma Mapping System "Helinuc"; Principle and Performances. Subject: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/16	1997	Dr. P. Khokhlov: The Network of Landing Probes. Subject: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/16/Add.1	1997	Dr. P. Khokhlov: The Radon Radiometer for Tracks Detection of Nuclear Explosion. Subject: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/16/Add.2	1997	Dr. P. Khokhlov: Aerogeophysical Method on Search Stage of the OSI. Subject: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/17	1997	Dr. V. Gorbachev: On Capabilities of the Mass Spectrometric Method in the OSI System. Subject: Radiation Measurements
		WS-1 CTBT/PC/III/OSI/WS/PR/18	1997	Mr. G. Brachet: OSI Radiochemical Highlights. Subject: Radiation Measurements
	Workshop Reports	CTBT/WS/OSI-6/1	2000	

ANNEX III

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PREPARATORY COMMISSION | preparatory commission for the comprehensive nuclear-test-ban treaty organization

TASK LEADER PAPER (CTBT/WGB/TL-4/40)

LIST OF EQUIPMENT FOR USE DURING ON-SITE INSPECTIONS

INTRODUCTION

1. According to the Treaty and Protocol provisions, the Conference of the States Parties, at its initial session, shall consider and approve a list of equipment for use during on-site inspections. Such list will define all types of equipment that should be made available by the Technical Secretariat for on-site inspections when required. Only approved and certified equipment may be brought without limitations to the territory of the inspected State Party subject to conformity of this equipment with the inspection mandate. Therefore development of the list of equipment for use during on-site inspections (hereafter referred to as OSI equipment) constitutes one of the important verification related tasks set forth in the Resolution establishing the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBT/MSS/RES/1) and being addressed by Working Group B (WGB) in a systematic way from the very beginning of its work.

2. This paper is intended to facilitate further development of the list of OSI equipment by WGB, including its discussion at the Thirty-Sixth Session. It contains information on previous efforts made and the current status of this work, as well as a suggestion on possible format and structure of the draft list based on the outcome of discussion on this issue in OSI Workshop-18 and further steps that could be taken to achieve further advance towards completion of this task.

DEVELOPMENT OF THE LIST OF EQUIPMENT AND ITS CURRENT STATUS

3. It should be noted that the initial WGB attempts to define OSI equipment were undertaken in the absence of practical experience of applying OSI techniques for the purpose of OSI similar to the multiyear experience of applying IMS techniques. Therefore this work began with determining the types and characteristics of anomalies to be searched in the course of OSI and, in some way, concepts for use of corresponding techniques and equipment under the overall OSI search logic. On that basis an initial definition of functional requirements and technical specifications for OSI equipment was being developed. At that stage OSI Workshops with participation of most

experienced national experts occurred to be a very useful tool for collecting available relevant knowledge and developing initial suggestions on OSI equipment. In most cases these suggestions provided a basis for development of corresponding formal proposals that were discussed and refined by WGB. In this way, for a number of OSI techniques WGB recommended approval of lists and specifications of relevant equipment, initially for testing and training purposes. Based on these approved specifications, the PTS, after their approval by the Preparatory Commission, elaborated corresponding detailed terms of reference and finally procured equipment for these techniques and initiated its testing and use in various OSI related activities, including the first integrated field exercise. This resulted in gaining experience for refinement of the equipment list and specifications as well as for further development of the concepts for use of equipment and standard operational procedures.

4. The current status of development of the list of OSI equipment for various OSI techniques and activities listed in paragraph 69, Part II of the Protocol is presented below:

Table 1.

Equipment for:	Formal Acceptance by WGB in:
Position finding – 69 (a)	CTBT/WGB-12/1, May 2000
Visual observations – 69 (b)	CTBT/WGB-12/1, May 2000
Video filming – 69 (b)	CTBT/WGB-12/1, May 2000, rev. CTBT/WGB-17/1, February 2002
Still photography – 69 (b)	CTBT/WGB-12/1, May 2000, rev. CTBT/WGB-29/1, September 2007
Multispectral imaging including infrared measurements – 69 (b)	None (initial suggestions from OSI Workshop-6)
Gamma radiation survey and RN analysis (low resolution) – 69 (c), 69 (d)	CTBT/WGB-8/1, February 1999
Xe detection – 69 (d)	CTBT/WGB-9/1, May 1999
Ar detection – 69 (d)	None
Gamma radiation survey and RN analysis (high resolution) – 69 (c), 69 (d)	CTBT/WGB-8/1, February 1999
Passive seismological monitoring for aftershocks – 69 (e)	CTBT/WGB-7/1, September 1998
Resonance seismometry – 69 (f)	None (initial suggestions from OSI Workshop-6)
Active seismic survey – 69 (f)	None (initial suggestions from OSI Workshop-6)
Magnetic field mapping – 69 (g)	CTBT/WGB-14/1, February 2001
Gravitational field mapping – 69 (g)	CTBT/WGB-14/1, February 2001
Ground penetrating radar – 69 (g)	CTBT/WGB-15/1, June 2001, an update remains under consideration
Electrical conductivity measurements – 69 (g)	CTBT/WGB-15/1, June 2001, an update remains under consideration
Drilling – 69 (h)	None (initial suggestions from OSI Workshop-4)

5. Taking into account the advance achieved it is deemed reasonable to proceed to the next stage – development of the draft list of equipment for use during on-site inspections that should be presented to the initial session of the Conference of the States Parties starting from reaching agreement on the possible structure and content of this draft list.

POSSIBLE STRUCTURE AND CONTENT OF THE DRAFT LIST

6. While establishing the overall structure of the draft list of equipment for use during on-site inspections under CTBT and defining its content it would be sensible to consider and utilize, as appropriate, approaches adopted already under existing international agreements. This idea has been discussed in detail by OSI Workshop-18 in November 2010. In particular, Workshop participants considered approaches based on the list of equipment accepted by the Organisation for the Prohibition of Chemical Weapons (OPCW) and concluded that it “could be a good starting point for further development of a template for the OSI list of equipment” under CTBT (CTBT/WS/OSI-18/1).

7. Following this conclusion a possible template to be used for the development of the draft list of equipment for use during on-site inspections could be established as follows:

Table 2. Draft List of Equipment for Use During On-Site Inspections

1 Description	**2 General operational requirements** *(including technique-defined)*	**3 Specific operational requirements**	**4 Certification criteria and procedures**	**5 Technical specifications**	**6 Calibration requirements**
Part 1. Core equipment for inspection activities and techniques *(items linked to activities and techniques listed in paragraph 69, Part II of the Protocol)*					
69(a) Equipment for position finding					
69(a).1 Satellite based position finding device	<Reference – document(s) agreed by WGB)>	<Reference>	<Reference>	<Reference>	<Reference>
69(a).2 …	<Reference>	<Reference>	<Reference>	<Reference>	<Reference>
…	<Reference>	<Reference>	<Reference>	<Reference>	<Reference>
69(b).1 Binoculars	<Reference>	<Reference>	<Reference>	<Reference>	<Reference>
69(b).2 Handheld camera for still photography	<Reference>	<Reference>	<Reference>	<Reference>	<Reference>
…	<Reference>	<Reference>	<Reference>	<Reference>	<Reference>

Part 2. Auxiliary equipment necessary for the effective and timely conduct of on-site inspections					
1. …	<Reference>	<Reference>	<Reference>	<Reference>	<Reference>

This template is suggested for consideration and refinement by WGB. One of the issues for further discussion mentioned in the report of OSI Workshop-18 is whether calibration requirements and calibration history need to be included in the list of equipment as a separate category. Other relevant issues could be also discussed and resolved.

FURTHER WORK ON THE LIST OF OSI EQUIPMENT

8. After setting an agreed template further work on progressive filling of its cells by the discussion by WGB and adoption of relevant reference documents that will contain corresponding characteristics for the specific equipment items could be done. This could take into account experience gained already from equipment testing and its use in exercises, progress achieved in the latest development of techniques and equipment (e.g. transition to digital photography, advance in the development of portable processing tools and data storage media, miniaturization and integration of equipment and so on). In parallel, further coherent development and refinement of concepts for use of different OSI technologies and equipment as well as development of corresponding standard operations procedures could be done. Remaining gaps shown in Table 1 could be gradually addressed and filled. The existing two-loop process established for equipment procurement could be also reviewed. Based on agreed parts of the draft list, the PTS could continue with procurement of OSI equipment and use it in various activities making also possible a prompt achievement of OSI readiness by entry of the Treaty into force. Active participation of States Signatories in this process is a vital precondition for achieving required progress in this work.

9. The nearest step in this direction is expected to be done by OSI Workshop-19. It is intended to review and refine possible operational requirements and technical specifications of equipment for the techniques and activities for the initial period of OSI, using an approach similar to OSI Workshop-6 and following corresponding recommendations of OSI Workshop-18. The outcome of OSI Workshop-19 will be delivered promptly to WGB for its consideration and further use in the development of the draft list of equipment for use during on-site inspections.

ANNEX IV

LIST OF PRESENTATIONS

Opening Session

1. Rozhkov, O., PTS, Opening Remarks.
2. Shchukin, V., Russian Federation, Briefing on the Objectives of Workshop-19 (CTBT/OSI/WS-19/PR/18)
3. Sateia, Gilbert, USA, Briefing on Workshop Programme (CTBT/OSI/WS-19/PR/17)
4. Wang Jun, China, Briefing on the Workshop Outcome (CTBT/OSI/WS-19/PR/01)
5. Sweeney, Jerry, USA, Guidance on Workshop Report Drafting (CTBT/OSI/WS-19/PR/21)
6. Deng, Hongmei, PTS, Administrative Information

Plenary Session:

1. Shchukin, V., Introduction for Development of OSI Equipment List (CTBT/OSI/WS-19/PR/19).
2. Arndt, R., OSI Equipment List – A Perspective form the PTS (CTBT/OSI/WS-19/PR/20).
3. Wang, Jun, China, technical Specifications for Video and Still Photography (CTBT/OSI/WS-19/PR/02).
4. Labak, P., PTS, Seismic Aftershock Monitoring System – Development of the OSI Equipment List (CTBT/OSI/WS-19/PR/14).
5. Bowyer, Theodore, USA, Concept of Operations for Radionuclide Measurements for On-Site Inspection (CTBT/OSI/WS-19/PR/15).
6. Walker, John, UK, Expert Group B1: Position finding and Visual Observation (CTBT/OSI/WS-19/PR/03).
7. Henderson, John, USA, Expert Group B2: Multispectral and Infrared Imaging (CTBT/OSI/WS-19/PR/04).
8. Ilijas, Boris, Croatia, Development of OSI Equipment List: Initial Period Techniques (CTBT/OSI/WS-19/PR/05).
9. Zahmatkesh, M.H. and Sabzian, M., Iran, Equipment Related Issues on On-Site Inspection (CTBT/OSI/WS-19/PR/06).

Expert Group A1:

1. Wang, Jun, China, Draft List of video and Photographic Equipment. (CTBT/OSI/WS-19/PR/07).

Expert Group A2:

1. Lindblom, P., Finland, Some Thoughts on SAMS (CTBT/OSI/WS-19/PR/08).
2. Belyashov, A., Kazakhstan, Assessment of Mobile Telemetric Complex Possibilities in Solving SAMS Tasks (CTBT/OSI/WS-19/PR/23).
3. Labak, P., PTS, Draft List of Equipment (CTBT/OSI/WS-19/PR/27).

Expert Group A3:

1. Bowyer, T. and Arndt, R., USA and PTS, Discussions Under the Guidance of the Co-Leaders (CTBT/OSI/WS-19/PR/16)

Expert Group B1:

1. Walker, J., UK, Draft List of Equipment for Position Finding and Visual Observation (CTBT/OSI/WS-19/PR/09).

Expert Group B2:

1. Henderson, J., USA, MSIR Specifications (CTBT/OSI/WS-19/PR/10).
2. Gaya-Pique, L., PTS, Points of Consensus from OSI Multi-Spectral Expert Meeting (CTBT/OSI/WS-19/PR/24).
3. Gaya-Pique, L., PTS, Draft List of Equipment for Multispectral Imaging and Infrared (CTBT/OSI/WS-19/PR/25).

Expert Group B3:

1. Feng Tiancheng, China, A Vehicle Mounted NaI Gamma Spectrometer System for OSI (CTBT/OSI/WS-19/PR/11).
2. Yonezawa, C., Japan, Radionuclide Analysis at the On-site Laboratory by Gamma-ray Spectrometry and Necessary Equipment for the Analysis (CTBT/OSI/WS-19/PR/12).
3. Ilijas, B., Croatia, Discussion Outlines (CTBT/OSI/WS-19/PR/13).

Closing:

1. Sweeney, J., USA, Brief on Workshop Report Drafting Schedules (CTBT/OSI/WS-19/PR/22).

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