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Remote Proctoring Implementation in the Nuclear Power Industry

A Review of Remote Proctoring for Knowledge Assessments

2022 TECHNICAL REPORT

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A Review of Remote Proctoring for Knowledge Assessments

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ABSTRACT

Remote proctoring is used as a tool to implement examinations at accredited institutions of higher education like the Bismarck State College Nuclear Uniform Curriculum Program training program, for the Multistate Bar Examination in the United States, and by the Spanish nuclear industry. This review, which includes academic and nonindustrial practices, was completed by EPRI to better understand issues related to the implementation of remote proctoring for knowledge evaluations at accredited nuclear power industry training programs. The conclusion of this review is that remote proctoring could be successfully employed in all the nuclear industry's training programs outlined in 10 CFR §50.120 (nonlicensed operator, shift supervisor, shift technical advisor, instrument and control technician, electrical maintenance personnel, mechanical maintenance personnel, radiological protection technician, chemistry technician, and engineering support personnel).

Keywords

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PRIMARY AUDIENCE: Utility personnel responsible for accrediting training programs in the nuclear power industry

SECONDARY AUDIENCE: Station personnel looking to implement remote proctoring

KEY RESEARCH QUESTION

Remote proctoring has been used successfully outside the nuclear power industry to grant academic degrees and technical certifications. Nuclear power plant training programs in the United States are regulated by the Nuclear Regulatory Committee (NRC) with additional guidance provided by the National Academy for Nuclear Training (NANT). This review examines the viability of implementing remote proctoring of knowledge examinations at nuclear power stations.

RESEARCH OVERVIEW

The applicable regulatory requirements associated with accredited training programs in the nuclear industry have been reviewed. This review includes applying established examination security concepts to aspects of remote proctoring (such as information technology requirements and cyber security concerns) that are not well established. This analysis is aided by reviewing the current experience of remote proctoring inside and outside the nuclear industry.

KEY FINDINGS

- Nuclear industry training programs identified in 10 CFR §50.120 (nonlicensed operator, shift supervisor, shift technical advisor, instrument and control technician, electrical maintenance personnel, mechanical maintenance personnel, radiological protection technician, chemistry technician, and engineering support personnel) accreditation standards and regulatory requirements related to examination security are generic in nature. There are no known regulatory barriers that would prevent the implementation of remote proctoring in these programs. Processes must be in place to maintain examination security and prevent compromise. The means to accomplish this are not specified in the regulatory documents.
- Remote proctoring is used extensively outside the nuclear industry for certification exams. The Multistate Bar Examination and Bismarck State College, the one institution of higher learning indirectly accredited by the Institute of Nuclear Power Operations (INPO) Nuclear Uniform Curriculum Program (NUCP), implement remote proctoring. There have been no issues with accreditation agencies.
- American Nuclear Insurers (ANI) is not opposed to remote proctoring when required, such as in a national emergency, provided that implementing such practices do not affect claim defense strategies. Instances of deviation from usual methods should be referred to ANI for review on a case-by-case basis to ensure proper consideration of all risk mitigation efforts. Section 8, Considerations for a Remote Proctoring Implementation Plan, provides an outline of considerations that can be submitted to ANI for review.

- An off-the-shelf computer purchased today has the resource requirements (for example, RAM, processor speed, internet capabilities) to implement remote proctoring software. However, internet connectivity may be a concern in some remote areas or with exceptionally large populations attempting to access examinations at the same time. Remote proctoring vendors have identified solutions to handle low bandwidth for the learner (end user).
- Operator training examination security requirements for the initial license written examination and the biennial requalification written examination are specified in NUREG 1021, Operator Licensing Examination Standards. This United States standard does not currently recognize remote examination practices but does allow alternative methods if approved by the NRC. The same standard is applied by the Spanish regulator, Consejo de Seguridad Nuclear (CSN). Remote proctoring could be implemented in the program exams given in each of these programs. Only these two regulatory examinations currently pose a barrier.

WHY THIS MATTERS

Remote proctoring offers the nuclear industry greater flexibility in administering knowledge examinations required to support effective evaluation of training. Remote learning is expected to expand greatly in the future as "on demand" training programs increasingly support industrial needs. As training shifts in the nuclear power industry to an online, e-learning platform, the flexibility to take an exam from a different location (for example, remote locations, off-site) will be required.

HOW TO APPLY RESULTS

Many vendors provide remote proctoring services; however, export compliant information regulations limit the selection of a vendor. Integration with the various learning management systems (LMSs) available will require engagement with the selected remote proctoring service. Section 8, Considerations for a Remote Proctoring Implementation Plan, provides a tool to implement remote proctoring at a nuclear power station.

LEARNING AND ENGAGEMENT OPPORTUNITIES

- EPRIJU Common Training Program
  https://publicdownload.epri.com/PublicAttachmentDownload.svc/AttachmentId=78618
- The following agencies and/or organizations may be interested in this technical report: US NRC, NEI, ANI, NANT, INPO, Conference on Nuclear Training and Education (CONTE)

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DEFINITIONS

artificial intelligence (AI). The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision making, and translation between languages.

browser lockdown. A program used to prevent access by the learner to anything other than the examination.

examination security. Processes, programs, and techniques used to prevent examination compromise.

export controlled information (ECI). Information that may be disseminated only to authorized personnel in accordance with 10 CFR §810, Assistance to Foreign Atomic Energy Activities.

learner. The person who receives the training and is evaluated.

live remote proctoring. The use of an actual person, typically knowledgeable in the subject matter, who makes use of various remote proctoring capabilities to proctor an examination. This person is available to the learners during the examination via an internet/intranet connection.

remote proctoring. A system used over the internet/intranet to accomplish all the functions traditionally provided by a proctor present at the examination site.

traditional proctoring. The process of supervising the administration of an exam. Duties include proper identification of examinees, briefing the learners, maintaining exam security, question clarification, and break management. The proctor is also responsible for preventing examination compromise in unusual or emergency situations. In a traditional setting, the proctor remains in the exam room and oversees all activities of the examinees to ensure integrity and answer questions about the exam.

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CURRENT INDUSTRY STANDARDS AND REGULATIONS

Nuclear industry training programs that are outlined in 10 CFR §50.120, Training and Qualification of Nuclear Plant Personnel [1] (nonlicensed operator, shift supervisor, shift technical advisor, instrument and control technician, electrical maintenance personnel, mechanical maintenance personnel, radiological protection technician, chemistry technician, and engineering support personnel), are required to implement training that "must be derived from a systems approach to training as defined in 10 CFR §55.4." This "systems approach to training" is commonly implemented as the systematic approach to training (SAT) model, although any training method derived from a systems approach would satisfy the requirement. Although there is no explicit mention of examination security in 10 CFR §50.120, examination security is implied by SAT principles. NUREG 1220, Training Review Criteria and Procedures [2], describes methods the Nuclear Regulatory Commission (NRC) will use to evaluate the training programs outlined in 10 CFR §50.120. NUREG 1220 addresses only the quality of the examinations. Operator training requirements are outlined in 10 CFR §55, Operators Licenses [3, 4]. Operator license examination security is required by 10 CFR §55.49, Integrity of Examinations and Tests [5,6]. Additional guidance regarding licensed operator examination security is provided in NUREG 1021, Operator Licensing Examination Standards [7].

The NRC recognizes accreditation as a method to comply with the regulations described earlier [8]. Nuclear industry training programs (operations, maintenance, and technical) are accredited by the Institute of Nuclear Power Operations (INPO). In 1985, INPO's board of directors formally established the National Academy for Nuclear Training (NANT). NANT integrates the training-related efforts of nuclear utilities, National Nuclear Accrediting Board, and INPO's training activities. Evaluation methods (such as examinations) are covered under the following NANT accreditation objectives [9]:

- Criterion 1.1: A systematic approach to training is defined by implementing policies and procedures that provide the flexibility of training processes and methods commensurate with the complexity of the job and with its importance to nuclear safety and reliability.
- Criterion 1.10: Records are maintained to document personnel qualifications for job assignments. Training program documentation supports management information needs.
- Criterion 2.3: Achievement of learning objectives is evaluated using reliable and valid test methods. Examinations are controlled and administered to maintain evaluation integrity and to prevent compromise.

Accreditation criterion 2.3 refers to both examination quality and security; however, this report addresses only examination security, not the quality or content of an evaluation. ACAD 02-004 mentions only "controlling and administering examinations to maintain evaluation integrity" as a topic for developing policy statements and procedures. INPO Nuclear Industry Standard Process,

NISP-TR-01, Systematic Approach to Training Process [10], briefly mentions examination security and still refers to traditional in-class proctoring. This document is controlled by the industry and may need to be changed to provide the necessary "guardrails" to implement remote proctoring.

For training programs identified in 10 CFR §50.120, the methods required to ensure examination security are not prescribed in any regulation or regulatory guidance. Therefore, the examination security methods need only to demonstrate compliance with NANT accreditation objectives. The technical colleges referred to in this report are accredited by the associated regional accreditation agency (such as the Higher Learning Commission of the North Central Association of Colleges and Schools). There have been no accreditation issues associated with remote proctoring for the schools and colleges contacted for this report.

NUREG 1021, Operator Licensing Examination Standards, is very prescriptive about examination security. The methods described by NUREG are based entirely on older methods of administering paper examinations using on-site facilities. For instance, room size and physical separation of candidates are described by NUREG. Facility licensees may propose alternative methods to ensure examination security. The NRC will review the proposal and rule on the alternative method. The implementation of remote proctoring for operator licensing examinations would have to receive individual site approval of any proposed alternative to the NUREG guidance. This guidance is applicable only to 10 CFR §55 operator licensing examinations and is not specified for the programs identified in 10 CFR §50.120 (nonlicensed operator, shift supervisor, shift technical advisor, instrument and control technician, electrical maintenance personnel, mechanical maintenance personnel, radiological protection technician, chemistry technician, and engineering support personnel).

Regulations outside NRC jurisdiction also need to be examined. For example,10 CFR §110, Export and Import of Nuclear Equipment and Material [11], controls the export and import of physical equipment and material (for instance, special nuclear material, byproduct material, source material). Associated with this regulation is 10 CFR §810, Assistance to Foreign Atomic Energy Activities [12]. This regulation is under the jurisdiction of the Department of Energy (DOE). Section 810 governs the export of technology for development, production, or use of reactors, equipment, and material subject to Section 110. Authorization is required from the DOE to transfer physical documents or electronic media or the transfer of knowledge and expertise. This is done through general and specific licenses issued by the DOE.

The DOE regulation is meant primarily for companies that desire to transfer nuclear technology through general and specific licenses. However, any exposure of site-specific information to inadvertent compromise would also fall under this regulation. Only authorized persons (as described later) may access this information. The nuclear industry, as discussed in this report, refers to production facilities and the accredited training programs associated with them. No license to transfer technology is being considered for these production facilities to support remote proctoring. Assistance to Foreign Atomic Energy Activities, 10 CFR §810, has been interpreted throughout the nuclear industry to be applicable for any training program that may expose site-specific technical information to unauthorized personnel.

Technologies for equipment outside the nuclear steam supply system, including but not limited to diesel generators and switchyard equipment, and other technologies not specifically designed for use in a nuclear reactor are outside of the scope of 10 CFR §810.

This regulation is not applicable to generic training programs with common-knowledge elements that do not contain site-specific information. In other words, if the training material for a specific discipline contains only information readily available to the public, such as fundamental academic topics, then it would not have to be considered export controlled information (ECI) compliant. Transfer of publicly available information, publicly available technology, or the results of fundamental research is outside the scope of 10 CFR §810.

Access to information and technology subject to 10 CFR §810 is restricted to U.S. citizens and U.S. lawful permanent residents and protected individuals under section 274B(a)(3) of the Immigration and Naturalization Act (8 U.S.C. 1324b(a)(3)). Examinations may contain specific information subject to 10 CFR §810. To prevent inadvertent transfer of material, access to examinations must be restricted accordingly. Servers located in the United States are used for this reason. Amazon and Microsoft, for example, both have cloud computing services that comply with these requirements (AWS GovCloud and Azure Government Cloud, respectively).

Based on the preceding review, there are no regulatory requirements or guidance documents that would prevent the implementation of, or require authorization from any government agency for, remote proctoring of knowledge evaluations of common-knowledge components in maintenance and technical training. ECI compliance is required for site-specific technical information that may be contained in an examination, to prevent inadvertent disclosure of the information to unauthorized personnel.

References

1. 10 CFR §55.49, Integrity of Examinations and Tests.
2. NUREG 1021, Operator Licensing Examination Standards.
3. 10 CFR §55, Operators Licenses.
4. 10 CFR §50.120, Training and Qualification of Nuclear Plant Personnel.
5. 10 CFR §55.49, Integrity of Examinations and Tests.
6. NUREG 1220, Training Review Criteria and Procedures.
7. 10 CFR §55, Operators Licenses.
8. Memorandum of Agreement Between the Institute of Nuclear Power Operations and the U.S. Nuclear Regulatory Commission, Appendix 3, September 11, 2013, ML131229A093.
9. NANT ACAD 02-01, The Objectives and Criterion for Accreditation of Training in the Nuclear Power Industry.
10. Nuclear Industry Standard Practice, NISP-TR-01, Systematic Approach to Training Process.
11. 10 CFR §110, Export and Import of Nuclear Equipment and Material.
12. 10 CFR §810, Assistance to Foreign Atomic Energy Activities.

2
STAKEHOLDER INPUT

The following have been identified as stakeholders in U.S. nuclear industrial training:

- **NRC** recognizes accreditation as an acceptable method to satisfy the requirements of 10 CFR §120, Training and Qualification of Nuclear Plant Personnel. NRC will provide further comments as requested by a licensee.
- **INPO** is concerned primarily with meeting accreditation standards. There is currently no effort by INPO to implement remote proctoring. Accreditation reviews are performed periodically for all INPO-accredited programs. These reviews would uncover and correct any exam compromise or exam security issues associated with examination security.
- **American Nuclear Insurers** (ANI) is concerned primarily with training programs for contractors, such as plant access training and radiation worker training. Changes in training protocols could potentially affect legal defenses used by ANI, so ANI wants to understand any new exposures that remote proctoring might present. Although ANI does not have a direct tie to maintenance and technical training, errors made by individuals trained in these programs could complicate a claims response.
- **The Nuclear Energy Institute** (NEI) has no concerns about the implementation of remote proctoring. NEI sponsors the Licensed Operator Focus Group, which is not currently seeking to apply remote proctor technology to licensed operator training programs.
- **Emerging technology plants** with new reactor plant designs want stringent control of examination material because it may contain proprietary information. This control of proprietary information needs to be considered across the learning management system (LMS) and the remote proctoring solution.

3
INFORMATION TECHNOLOGY REQUIREMENTS

Remote proctoring software would be considered a business application and will need to be placed on company computer assets. Significant coordination may be required with on-site information technology (IT) groups for a remote proctoring software application to be installed on a company computer asset. In addition, periodic functionality checks would be required to ensure that the software remains compatible as local security and software updates are performed. The applicable site procedure(s) for local area network (LAN) and wide area network (WAN) applications will control the use of this software. There is no direct tie with the cyber security rule, which requires protection of digital computer and communication systems and networks from cyber attacks [1]. The security measures in place at each site to protect critical data assets, identified in the cyber security rule, will also prevent hacking via remote proctoring software. If the decision is made for learners to use their own computers, then the secure browser must be placed on their computers. However, software control is lost on a learner's personal computer. Implementation of remote proctoring would be best implemented on company-issued computers because administrative rights can be controlled, thereby limiting the installation of unwanted software on the computer that is used to implement the remote examination proctoring application.

The remote proctoring application is typically accessed through a web browser. It should be accessible from anywhere with an adequate internet connection and proper credentials. The application will typically run on Windows or Mac computers. Test takers will be required to share their webcams and their screens while taking the exam and/or completely disconnect from the internet. In some cases, an additional camera may be used for added security. Hardware recommendations for the test taker computer include 8GB RAM, 640×640 resolution webcam, and a 10 Mb/sec (upload and download) internet connection. Hardware recommendations for a proctor administering and monitoring an exam include 8GB RAM, 100 Mb/sec (upload and download) internet connection, microphone (to communicate via voice if available), 640×640 resolution webcam, and multiple monitors (if viewing multiple sessions is possible). Browser extensions are used to connect with the service. A browser lockdown can be used in conjunction with the proctoring application, although this will require an extension to a browser or an additional application to be downloaded. Remote proctoring solutions allow for facial recognition but rely on software to process a video stream with effectively high resolution. The exam registration process checks for all needed requirements or applications such as audio/video software, the appropriate Windows platform, a web browser, Java script, and connection speed and stability. The registration process can be done ahead of the scheduled examination time to allow problems to be addressed.

A remote proctoring application can be hosted on servers locally or on the cloud. If ECI compliance is required, the servers must be ECI compliant per 10 CFR §810. Local servers must have export control policies in place; cloud servers can use ECI-compliant solutions, such as Amazon GovCloud.

Integration of a remote proctoring solution with the LMS "exam engine" is a possible implementation feature. This would allow the learner to open a single application (e-learning platform) and take the evaluation. Having a learner launch an exam in one application and then open an additional application may provide unnecessary process steps. Proctoring software solutions allow importing the examination or integration into the LMS.

References

1. RG-5.71, Cyber Security Programs for Nuclear Facilities.

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REMOTE PROCTORING TECHNOLOGY

Commercially available software for remote proctoring has been developed largely in response to the needs of higher education for academic programs. The nuclear industry is just beginning to explore this remote proctoring space as a response to the COVID-19 pandemic. The nuclear industry's responsibility for examination security is to prevent inadvertent exam compromise to maintain the authenticity of the assessment (examination). Verbatim compliance with administrative procedures is an effective strategy to meet this regulation. The overwhelming majority of exam security issues involve the loss of control of examination materials. Examples of this loss of control of examination materials typically include leaving the exam where it can be seen, exam room doors not being locked, not clearing the memory on the copier, and handing the answer key out instead of the exam.

Willful violation of exam security requirements by learners (cheating) is outside the scope of the regulation; however, a continuing review of the technological capabilities to cheat is a best practice to maintain the authenticity of assessments. This review of the technological capabilities to cheat will also highlight the different features of remote proctoring applications used to prevent cheating. Current methods of cheating include the following:

- Sending screen shots to a friend or commercially available contract sites
- Screen sharing with a friend or subject matter expert
- Using an external projector facing away from the webcam so friends can provide answers to test questions
- Employing technological devices, such as smart phones, watches, or small undetectable Bluetooth devices
- Impersonation of the learner by a person knowledgeable in the subject matter
- Intercepting video feeds and inserting a prerecorded video into the webcam feed
- Using virtual machine software, with the capacity to run two operating systems on the same computer, to access the internet or other files
- Recording the exam

Remote proctoring software has the capability to be as feature rich as the client requests. In general, this report reviews the most common features of remote proctoring software and some more advanced features (artificial intelligence). Useful features that can replace or improve on live in-person proctoring will be highlighted. Remote proctoring software may contain any combination of the following features:

- Identification verification
- Human proctors

- Live video and audio
- Recording/review
- Browser lockdown
- Artificial intelligence (AI)

Multifactor identification allows the verification of the learner's identity. This is an electronic authentication practice in which learners will be given access to the examination application only after they have presented two or more identification factors (pieces of evidence). These factors may include verification of something in the learner's possession (identification card), something only the user knows (such as a one-time generated password), and inherence (fingerprints, vocal scans, retina and iris patterns). Each additional factor required decreases the likelihood that an unauthorized person could access the examination.

Live video from a web camera allows the proctor to view the learner taking the exam in a remote location. Additional cameras with various viewing angles up to a 360-degree view of the exam room can be used to view the area surrounding the learner prior to starting the knowledge evaluation. Intentionally placed web cameras can also capture the learner's screen while the learner is taking the exam. Screen sharing is a form of a video feed that allows the proctor to view the learner's computer screen. Live audio allows all learners to chat with the proctor and allows the proctor to respond individually or disseminate information to all learners simultaneously. The proctor or the learner can initiate a phone call if needed. All video and audio feeds can be recorded for archival purposes and/or for review later. In summary, live remote proctoring provides all the same functions as a traditional proctor in an exam room.

Browser lockdown is a remote proctoring software feature that limits the functionality of the learner's computer while the examination is in progress. Browser lockdown can prevent the examinee from taking screenshots, copying and pasting, and/or opening other applications or websites. This feature can also be used to block access to the intranet or internet. In addition, changing the browser lockdown security settings will allow the learner to access reference materials for an open reference examination. These approved reference materials may be effective reinforcement for human performance tools such as procedure use and adherence. Data loggers can record every action taken on the keyboard and every IP address visited. The logged data can then be reviewed after the exam for identification of any prohibited sites.

These features can be further enhanced using AI. Multifactor authentication can be enhanced by using an inherence factor (for example, face recognition can be used for identification of examinees). Threshold flags can be employed using AI to identify abnormal conditions. For instance, AI threshold flags can be set to look for movement, like a learner picking up a cell phone or leaving a designated area. Threshold flags can monitor for extra people in the room. Eye movement outside the camera angle can trigger a threshold flag. Audio can be monitored by AI with low-level sound thresholds flagged for murmurs or whispers. Voice recognition can identify the voice of the examinee and flag other voices. Experience has shown that many false flags need to be evaluated by the proctor when using AI. When employed in conjunction with live proctoring, AI can assist the proctor in identifying potential cheating. It can also be used to eliminate human proctoring by using the record-and-review function. In this instance, threshold flags generated by AI during the examination period are manually validated or dismissed after the exam has taken place.

Technological solutions like the ones listed here can also be combined with nontechnological approaches (administrative procedures) to limit the ability of a learner to cheat. Perhaps the best example of a nontechnological approach is the use of higher cognitive questions combined with time limits. These time limits can be imposed on an individual question basis or for the entire examination. Presumably, well-prepared learners do not need excessive amounts of time to answer questions.

References

1. "Why Locked Down Browsers Fail the Security Test," https://cdn2.hubspot.net/hubfs/2956392/ExamSoft_ebook_Complete-Device-Control.pdf (accessed January 27, 2021).

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CURRENT EXPERIENCE OUTSIDE THE NUCLEAR INDUSTRY

Remote proctoring is being used extensively outside the nuclear industry and the number of vendors providing this service is rapidly expanding. Two such vendors investigated as part of this research include Proctor360 and ExamSoft. These two vendors have more than 10 years of working experience in the nuclear industry. Proctor360 is currently working with nuclear power stations and is used extensively outside the nuclear industry. ExamSoft provides remote proctoring of most of the bar examinations in the United States.

Bismarck State College has a program for training nuclear personnel and is recognized by INPO through the Nuclear Uniform Curriculum Program (NUCP). It adheres to all the NANT accreditation objectives and criteria. Remote proctoring has been used by Bismarck State College for 10 years when implementing knowledge evaluations. Bismarck State employs the webcam, screen share, video and audio recording, and browser lockdown components of a remote proctoring system. A live proctor is not used; however, the session recording is reviewed later by the college instructor/proctor. Nontechnical solutions to deter cheating are also used. Learners must sign and acknowledge the honor code. In addition, time limits are placed on the learner taking the examinations. Cheating results in a failing grade and potential expulsion from the program. An expulsion of this type can be reported to other institutions, thereby significantly increasing the consequences of cheating. Bismarck State College has not experienced any accreditation issues with examination compromise or integrity. During the recorded exam session, review instructors have caught persons attempting to cheat.

Ivy Technical Community College in Indiana is another educational institution implementing remote proctoring. It is the largest statewide single-agency accredited technical community college in the United States. This organization administers approximately 200,000 examinations per year to a worldwide clientele. There have been no issues with the accreditation agencies. The only implementation issues were associated with internet connectivity and single platform access. Large numbers of learners live in rural areas with minimal bandwidth. The vendor was able to resolve this issue without any reduction in quality or in the ability to proctor the exams. The learning management system is not seamless with the proctoring software. This organization employs the most basic remote proctoring technologies, using only a web camera and live proctors. In addition, a proctor–learner ratio of 1:5 is imposed and 360-degree previews of the exam surroundings are required. Observant proctors have caught test takers cheating.

The bar exam is administered by the National Conference of Bar Examiners (NCBE). Prior to the outbreak of SARS-CoV-2, the virus responsible for the COVID-19 disease and pandemic, examinations were given on a periodic basis at various testing centers across the United States. The July 2021 bar exam was canceled because testing centers had closed in response to the COVID-19 lockdown restrictions. As a result, around 40,000 potential new attorneys were unable to take the bar exam via the NCBE's in-person implementation exam process. Various

jurisdictions and states responded differently to the lockdown. For instance, New York and Massachusetts hired the same commercial online proctoring company to administer the exam. The remote proctoring software in this case employed AI and recorded each examination for review later. Examinations were downloaded onto individual computers and then they were completely disconnected from the internet (wireless and wired internet blocked by the vendor software). Once the examinations were complete, the examination and the recorded session were submitted to the examiners and all AI flags were reviewed. New York caught people attempting to cheat, but Massachusetts did not see any attempts. Live remote proctoring was not used, to avoid internet connectivity issues.

The National Council Licensure Examination (NCLEX) is a nationwide examination for the licensing of nurses in the United States, Canada, and Australia. It has been used since 1982, 2015, and 2020, respectively. This examination is not yet offered online in a remote location; however, nursing schools do employ remote proctoring in their academic programs. Different institutions have chosen different vendors.

ECI imposes restrictions that no one outside the nuclear industry has had to deal with. This limits the selection of vendors to those who can put their product on an ECI-compliant computing server. Vendors also must be U.S. citizens (or have an approved immigration status) to have any access to this information. Compliance with ECI regulations may also drive records retention requirements to facilitate mandatory periodic reporting.

Currently, no statistical analysis has been performed on the effectiveness of remote proctoring in the nuclear power plant industry. Nuclear power plant training programs are just starting to implement the technology; therefore, there is limited information available in corrective action databases to date. The educational institutions contacted for this report have not identified metrics on performance with respect to in-person versus remote proctoring examinations.

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INTERNATIONAL EXPERIENCE

The Spanish nuclear power industry recently employed remote proctoring for operator training programs in response to the COVID-19 pandemic. This industry is a member of the World Association of Nuclear Operators (WANO) and is committed to the systematic approach to training and the NANT accreditation objectives and criteria. As with the U.S. NRC, Spain also has a national regulatory agency, the Consejo de Seguridad Nuclear (CSN; English translation: National Security Council). The Spanish nuclear fleet operating services company Tecnatom is responsible for delivering this training. Tecnatom has provided insight to this review of remote proctoring in the nuclear power industry. No exam security events resulting from implementation of remote proctoring have been identified by Tecnatom. CSN has positively responded to implementation of remote proctoring practices to adapt to the COVID-19 pandemic. Furthermore, unofficial conversations about the possibility of turning some of the temporary remote proctoring implementation strategies into permanent official practices have occurred; however, no official statements or changes in regulation have been made.

Various combinations of remote proctoring are being used in both the operator initial and requalification training programs. Essay questions are used for examinations in both programs, whereas operator training programs in the United States use predominantly multiple-choice exam questions.

Initial operator training program exams are administered by a secure online platform provided by the Swedish company Exam.net. This platform uses a browser lockdown feature capable of varying degrees of security and allows the proctor to select the appropriate security level. The lowest setting allows the learner to use any browser in the full-screen mode. Any attempt to exit the full-screen mode will lock the exam and send a notification to the proctor. The exam proctor must grant permission for the learner to reenter the exam. Higher security settings prevent exiting the full-screen mode until the exam is submitted. The Microsoft Teams application is used in conjunction with the secure online Exam.net platform to provide live proctoring. The proctor requires each learner to provide a 360-degree view of the room prior to authorizing the examination. Learners are then allowed to access the examination with a password provided by the proctor. The video and audio feeds provided by the Microsoft Teams application are used by the proctor to detect potential examination security issues. The maximum proctor-to-learner ratio has been limited to 1 proctor to 15 learners.

Normally the initial written examination for an operator license is given in Madrid at the CSN offices. During the COVID-19 pandemic, however, the regulator agreed to administer the examination at each site, using video conference tools and pan, tilt, zoom (PTZ) cameras. The PTZ cameras are a special type of camera, typically used in surveillance systems, that allows remote control of the camera's pan, tilt, and zoom. A similar remote proctoring approach was used to administer the operating examination on the simulator.

For requalification, the operators take an exam on the Moodle learning management system using an examination plug-in. This allows learners to take the requalification exam at a time of their choosing. The platform does not place any navigation restrictions on the learner's computer system or perform any type of screening of the exam environment. To maintain exam security, the questions are selected randomly by the examination plug-in from a large exam question bank. This exam security strategy for the requalification exam is enhanced by employing a time limitation to prevent the harvesting of exam content.

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SUMMARY AND CONCLUSIONS

Defeating the examination security features of a remote proctoring application requires forethought and a level of computer proficiency by the learner (for example, installing a hypervisor to facilitate virtual machine software) such that if these actions were taken, they would be considered willful misconduct. Personnel in the nuclear industry face significant consequences for willful misconduct (cheating); however, the willful misconduct of a learner to bypass the remote proctoring exam security features implemented during a knowledge evaluation is beyond the scope of this report.

Section 8 of this report, Considerations for a Remote Proctoring Implementation Plan, can be used to develop and implement a strategy for remote proctoring of knowledge evaluations. This section was developed with ANI and should be used as a tool to help satisfy the examination security requirements for all nuclear training programs outlined in 10 CFR §50.120 (nonlicensed operator, shift supervisor, shift technical advisor, instrument and control technician, electrical maintenance personnel, mechanical maintenance personnel, radiological protection technician, chemistry technician, and engineering support personnel). The findings of this report are based on the following:

- A review of nuclear industry regulations, guidelines, and nuclear industry standardized processes
- Continued implementation of remote proctoring in the industry's only Nuclear Uniform Curriculum program (NUCP), at Bismarck State College
- Successful application of remote proctoring in higher education and professional certification examinations
- International implementation of a CSN-approved remote proctoring system within the Spanish nuclear power generation industry

The review of the nuclear power industry regulations and guidelines did not reveal any barriers that would prevent the implementation of a remote proctoring strategy for knowledge evaluations. ECI compliance is complicated and must be reviewed by the applicable site legal departments. Publicly available published research is not required to be ECI compliant. The Bismarck degree program is an example of this. The proposed EPRI training initiative for maintenance and technical training programs identified in 10 CFR §50.120 will contain only common knowledge elements agreed to by an industry working group. These working groups set the scope of the EPRI Common Training curricula and do not include site specific information and/or plant designs. Common training programs that do not contain site specific information, or site-specific reactor plant designs, would most likely be designated as EAR99 by the Bureau of Industry and Security.

Further review of practices in the nuclear power industry revealed that a remote proctoring strategy is employed by the INPO NUCP-approved associate degree in nuclear power technology at Bismarck State College. This Bismarck State College program has been using and reviewing this remote proctoring technology through several nuclear power plant site accreditation cycles over a ten-year span. Nuclear power stations that hire Bismarck State College nuclear power associate degree graduates are able to process exemptions for the appropriate portions of the stations' training programs. However, domestic and international stations implementing off-site remote proctoring should be aware of potential cultural challenges imposed on the learner by moving the traditional examination environment to a less controlled, more personal environment.

Successful implementation of remote proctoring strategies has been identified outside the nuclear power industry. One example of this is a knowledge evaluation to establish competence covering six areas of law (constitutional law, contracts, criminal law, evidence, real property, and torts) for the Multistate Bar Examination (MBE). The results of the MBE are used, in part, to grant licensure to practice law in a state.

Any remote proctoring implementation plan (see, for example, section 8, Considerations for a Remote Proctoring Implementation Plan) should also contain a review by ANI. ANI is not opposed, in principle, to implementing remote proctoring of knowledge evaluations; its primary concern is plant access training. A review of the implementation plan by ANI would allow it to modify its litigation strategies as deemed necessary.

There are many options with commercially available remote proctoring software. ECI compliance, if required, limits the vendor selection to those that can prove these compliance requirements. However, as demonstrated by Bismarck State College, the main components of current remote proctoring software satisfy the accreditation objectives associated with maintaining the integrity of the evaluation method. These main features improve the ability of the proctor to oversee the examination and include the following:

- Learner verification/identification
- Browser lockdown
- Video- and audio-based session recording
- Pre-examination review of the surroundings
- Time limits
- Proctor-to-learner ratio limitations
- Screen share

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CONSIDERATIONS FOR A REMOTE PROCTORING IMPLEMENTATION PLAN

Background

The response to the COVID-19 pandemic—specifically, the imposition of lockdowns and social distancing—has created a need to find and implement creative strategies to allow businesses, schools, government agencies, and the like to operate in compliance with local, state, and federal restrictions. In the context of education and knowledge/competency assessments in the workplace, remote proctoring is rapidly becoming a common solution for onboarding new employees, as well as for providing continuing education to current employees. However, the benefits of implementing a successful remote proctoring system extend beyond the current global health crisis and could be employed successfully in all nuclear industry training programs outlined in 10 CFR §50.120 (nonlicensed operator, shift supervisor, shift technical advisor, instrument and control technician, electrical maintenance personnel, mechanical maintenance personnel, radiological protection technician, chemistry technician, and engineering support personnel).

Intent

This supplemental document serves to outline the benefits of remote proctoring to nuclear stations, offers important considerations when examining the viability of remote proctoring, and outlines key recommendations for designing and implementing a remote proctoring system. The recommendations presented in this report have been approved by American Nuclear Insurers (ANI) as both necessary and appropriate for transitioning to remote proctoring learning and testing but does not preclude ANI from requiring final review of each station's final system design. Because countless vendors are available to provide services addressing each of these recommendations, specific hardware and/or software recommendations are not made. Stations are encouraged to contact vendors that provide services that best meet their individual needs and/or requirements.

Benefits

The benefits of implementing a remote proctoring system include, but are not limited to, the following:

- Reduced cost compared with employing a full-time, on-site proctor
- Reduced resource needs compared with maintaining a dedicated central testing center onsite
- Reduced time loss for employees when traveling to and from testing centers

- Expedited learning and testing by providing employees the opportunity to access recorded educational content and complete online assessments at their pace and at a time and place tailored to their specific needs
- Reduced scheduling conflicts or challenges by reducing dependency of learning on proctor access
- Reduced time-to-hire and cost-to-hire by reducing logistical requirements for newly hired employees
- Maximized use of downtime during station maintenance outages

Considerations

When considering the implementation of a remote proctoring system at a nuclear power station, special attention must be given to the following:

- Regulations governing the various aspects of implementing a remote proctoring system
- Educational content and examination materials that contain proprietary and/or sensitive information
- Building a secure network for storing educational content and examination files, as well as proctor/learner/class communication
- Maintaining examination security and preventing compromise
- Ensuring strong, stable, and dependable internet connectivity
- Thorough learner identity verification
- Adequate hardware to run the various remote proctoring components
- Selecting software that complies with the various regulatory agencies empowered with overseeing the implementation of a remote proctoring system

Recommendations

Regulatory Considerations

Implementing a remote proctoring system at a nuclear station requires the following regulatory considerations:

- Implementing systems approach training as defined by 10 CFR §55.4, and in compliance with 10 CFR §50.120, Training and Qualification of Nuclear Plant Personnel
- Maintaining exam security in compliance with NANT accreditation objective 2.3
- Exam quality compliance with NUREG 1220
- Remote proctoring service approval by ECI

Network Security

Network security is an integral component of a remote proctoring system at a nuclear station and should ensure secure communication and file sharing between proctor and learners, as well as secure storage of educational content and examination materials. Security measures in place to protect critical data assets, identified in the cyber security rule, will suffice to protect the network from cyber attacks via remote proctoring software.

Examination Materials Security and Compromise Prevention

Individual nuclear stations are responsible for securing examination materials and preventing inadvertent examination materials compromise. Recommended methods to safeguard examination materials include the following:

- A thorough identity verification protocol, such as two-factor identification
- The capacity to draw and randomize test questions from an expansive test question bank
- A set amount of time for each question to be answered
- Using remote proctoring software that features security settings allowing restricted access to certain programs, applications, and/or browsers during an examination and for screen sharing functions to require examinee screens to remain in full-screen mode

Software

The following functionalities are recommended when selecting software vendors to construct a remote proctoring system at a nuclear station:

- File sharing
- Team communication
- Videoconferencing
- Secure educational content and examination materials storage
- Classroom session recording and recording storage
- ECI-approved remote proctoring service integrated into a learning management service
- Identity verification
- Learner attestation: “I attest that I have reviewed the content presented in this module, I am now knowledgeable on the content matter herein, and I am prepared to be tested for competency.”

Hardware

Proctor computer:

- Minimum of 8 GB RAM
- 640×640 resolution webcam
- Stable internet connection with a consistent minimum upload/download speed of 100 Mb/sec

- Multiple monitors
- Microphone
- Speaker

Test taker computer:

- Minimum of 8 GB RAM
- 640×640 resolution webcam
- Stable internet connection with a consistent minimum upload/download speed of 10 Mb/sec
- Microphone (optional)
- Speakers

Classroom Recommendations

A successful remote proctoring system must allow the proctor to do the following:

- Communicate easily with class and/or individual learners via messaging and/or videoconferencing
- Share files with class and/or individual learners
- Record sessions for on-demand viewing
- Securely store recorded sessions, modules, and content
- Restrict access to educational content and examinations to control classroom pace
- "Lock" documents containing sensitive and/or proprietary content

A
TRANSLATED TABLE OF CONTENTS

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EPRI PREPARED THIS REPORT.

核能行業遠程監督執行

知識評估遠程監督審查

3002024148

最終報告，2022年9月

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摘要

認證高等教育機構採用遠程監督作為一種考核工具，如俾斯麥州立學院核能統一課程計畫培訓、美國多州律師考試以及西班牙核能行業開展的考試。本次審查由美國電力科學研究院完成，其中包括學術和非行業實踐，目的是更充分了解認證核能行業培訓計畫中通過遠程監督進行知識評估的相關問題。本次審查的結論認為，遠程監督可以成功應用於10 CFR §50.120（無證操作人員、班次主管、班次技術顧問、儀器和控制技術人員、電氣維護人員、機械維護人員、放射防護技術人員、化學技術人員和工程支持人員）中概述的所有核能行業培訓計畫。

關鍵字

認證
人工智能
考核安全
遠程監督

目錄

Mise en œuvre de la surveillance à distance des examens dans l'industrie nucléaire

Aperçu des possibilités de surveillance à distance pour les contrôles des connaissances

3002024148

Rapport final, septembre 2022

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RESUME

La surveillance à distance est utilisée comme outil pour les examens dans des établissements d'enseignement supérieur accrédités, notamment dans le cadre du programme de formation Nuclear Uniform Curriculum Program du Bismarck State College, pour l'examen de barreau multi-étatique aux États-Unis et dans l'industrie nucléaire espagnole. L'EPRI a effectué cette étude des pratiques universitaires et non industrielles pour mieux comprendre les enjeux liés à la mise en œuvre de la surveillance à distance des contrôles des connaissances dans les programmes de formation d'établissements accrédités de l'industrie nucléaire. La conclusion de cette étude est que la surveillance à distance pourrait être employée efficacement dans tous les programmes de formation de l'industrie nucléaire indiqués dans 10 CFR §50.120 (opérateur sans licence, superviseur d'équipe, conseiller technique d'équipe, technicien instruments et contrôles, personnel d'entretien des systèmes électriques, personnel d'entretien des systèmes mécaniques, technicien de protection radiologique, technicien chimique et personnel de soutien à l'ingénierie).

Mots-clés

Accréditation
Intelligence artificielle
Sécurité des examens
Surveillance à distance

TABLE DES MATIERES

Implementierung von „Remote Proctoring“ in der Kernkraftindustrie

Untersuchung von Remote Proctoring für Wissensprüfungen

3002024148

Abschlussbericht, September 2022

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ABSTRAKT

„Remote Proctoring“ (Fernprüfung) wird an akkreditierten Hochschulen, wie z. B. dem Bismarck State College für das Schulungsprogramm Nuclear Uniform Curriculum Program (einheitliches nukleares Lehrplanprogramm), als Instrument zur Durchführung von Prüfungen, für die „Multistate Bar Examination“ (Mehrstaatliche Anwaltsprüfung) in den Vereinigten Staaten, sowie von der spanischen Nuklearindustrie eingesetzt. Die vorliegende Untersuchung, die sowohl akademische als auch nicht-industrielle Praktiken beinhaltet, wurde vom EPRI durchgeführt, um ein besseres Verständnis für die Probleme bei der Implementierung von Fernprüfungen für Wissensbewertungen in akkreditierten Schulungsprogrammen der Kernkraftindustrie zu erlangen. Diese Untersuchung führt zu der Schlussfolgerung, dass die Fernprüfung erfolgreich in allen in 10 CFR §50.120 beschriebenen Ausbildungsprogrammen der Nuklearindustrie (nicht lizenzierte Bediener, Schichtleiter, technische Schichtberater, Geräte- und Steuerungstechniker, elektrisches Wartungspersonal, mechanisches Wartungspersonal, Strahlenschutztechniker, technische Chemiker und technisches Hilfspersonal) eingesetzt werden könnte.

Schlüsselwörter

Akkreditierung
Künstliche Intelligenz
Prüfungssicherheit
Fernprüfung (Remote proctoring)

INHALT

原子力発電業界でのリモート監督の実施

知識評価のためのリモート監督のレビュー

3002024148

最終報告書　2022年9月

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要約

リモート監督は、Bismarck State College の原子力統一カリキュラムプログラムのトレーニングプログラムのような認定高等教育機関において、米国のマルチステート司法試験向けに、またスペインの原子力業界によって、試験を実施するためのツールとして使用されている。本レビューは、学術的および非業界的慣行を含み、認定原子力業界トレーニングプログラムにおける知識評価のためのリモート監督の実施に関連した課題をよりよく理解するため、EPRI が実施した。本レビューの結論は、米国連邦規制基準10 CFR 50.120 が概要を示す、すべての原子力業界のトレーニングプログラム（ライセンスを持たない事業者、シフトスーパーバイザー、シフトテクニカルアドバイザー、計装および制御技術者、電気保全担当者、機械保全担当者、放射線防護技術者、化学技術者、およびエンジニアリングサポート担当者）において、リモート監督を正常に採用できるとしている。

キーワード

認定
人工知能
検査セキュリティ
リモート監督

目次

원자력 산업계의 원격 감독 구현

지식 평가를 위한 원격 감독의 검토

3002024148

최종 보고서, 2022년 9월

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초록

원격 감독은 비스마르크 주립대와 같은 공인 고등 교육 기관의원자력 표준 커리큘럼 교육 프로그램, 전미사법시험, 스페인 원자력 업계에서 시험을 시행하기 위한 도구로 사용되고 있습니다. 이 검토는 학문적 및 비산업적 관례도 포함하며 공인 원자력 산업 교육 훈련 프로그램에서 지식 평가를 위한 원격 감독 구현과 관련된 사안을 더 잘 이해하도록 EPRI가 완성했습니다. 검토의 결론은 원격 감독을 10 CFR §50.120에 간략하게 기술된 모든 원자력 산업계의 교육 프로그램(비면허 사업자, 교대근무조 감독관, 교대발전부장, 기기 및 제어 기술자, 전기 유지관리 기술자, 기계 유지관리 기술자, 방사선 방호 기술자, 화학 기술자 그리고 엔지니어링 기술 인력)에서 성공적으로 사용할 수 있다는 것입니다.

키워드

인정
인공지능
시험 보안
원격 감독

목차

Implementação de aplicações de provas remotas no setor de energia nuclear

Análise de aplicações de provas remotas para avaliações de conhecimento

3002024148

Relatório final, setembro de 2022

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RESUMO

As aplicações de prova remotas são usadas como ferramenta para a aplicação de exames em instituições de ensino superior certificadas, tais como o programa de treinamento do Nuclear Uniform Curriculum Program (Programa de currículo nuclear uniforme) do Bismarck State College para o Exame de ordem de multiestadual dos Estados Unidos e pelo setor nuclear espanhol. Esta análise, que inclui práticas acadêmicas e não industriais, foi realizada pelo EPRI para melhor entendimento de questões relacionadas à implementação de aplicações de provas remotas para avaliações de conhecimento em programas de treinamento credenciados do setor de energia nuclear. A conclusão desta análise é que a aplicação de provas remota poderia ser utilizada com sucesso em todos os programas de treinamento do setor nuclear listados na norma 10 CFR §50.120 (operador não licenciado, supervisor de turma, orientador técnico de turno, técnico de instrumento e controle, pessoal de manutenção elétrica, pessoal da manutenção mecânica, técnicos de proteção radiológica, técnico em química, e pessoal de apoio à engenharia).

Palavras-chave

Certificação
Inteligência artificial
Segurança de exames
Aplicação de provas remotas

ÍNDICE

Implementação de Supervisão Remota na indústria da energia nuclear

Uma análise da Supervisão Remota para avaliações de conhecimento

3002024148

Relatório final, setembro de 2022

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SINOPSE

A supervisão remota (Remote Proctoring) é utilizada como ferramenta para implementar exames em instituições acreditadas do ensino superior, como o programa de formação Nuclear Uniform Curriculum Program do Bismarck State College, para o Multistate Bar Examination (Exame à Ordem dos Advogados Multiestados) nos Estados Unidos, e pela indústria nuclear espanhola. Esta análise, que inclui práticas académicas e não industriais, foi concluída pelo EPRI para melhor compreender as questões relacionadas com a implementação da supervisão remota para avaliações de conhecimentos em programas de formação acreditados da indústria de energia nuclear. A conclusão desta análise é de que a supervisão remota poderia ser utilizada com sucesso em todos os programas de formação da indústria nuclear descritos em 10 CFR §50.120 (operador não licenciado, supervisor de turno, consultor técnico de turno, técnico de instrumentos e controlo, pessoal de manutenção elétrica, pessoal de manutenção mecânica, técnico de proteção radiológica, técnico químico e pessoal de apoio à engenharia).

Palavras-chave

Acreditação
Inteligência Artificial (IA)
Segurança do exame
Supervisão remota (Remote Proctoring)

ÍNDICE

Implantación de la supervisión remota en el sector de la energía nuclear

Análisis de la supervisión remota en las evaluaciones de conocimientos

3002024148

Informe final, septiembre de 2022

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RESUMEN

La supervisión remota se utiliza como herramienta para realizar exámenes en instituciones acreditadas de educación superior, como el programa formativo *Nuclear Uniform Curriculum Program*del Bismarck State College; para el Examen de Abogacía Multiestatal de Estados Unidos y para el sector nuclear español. EPRI ha llevado a cabo es análisis, que incluye prácticas académicas y no industriales, para comprender mejor los problemas relacionados con la implantación de la supervisión remota en las evaluaciones de conocimientos de los programas formativos acreditados del sector de la energía nuclear. De este análisis se concluye que la supervisión remota podría utilizarse con éxito en todos los programas formativos del sector nuclear descritos en 10 CFR §50.120 (operarios sin licencia, supervisores de turnos, asesores técnico de turnos, técnicos de instrumentación y control, personal de mantenimiento eléctrico, personal de mantenimiento mecánico, técnicos de protección radiológica, técnicos en química y personal de apoyo en ingeniería).

Palabras clave

Acreditación
Inteligencia artificial
Seguridad de los exámenes
Supervisión remota

CONTENIDO

Implementering av tentamensvakt på distans inom kärnkraftsindustrin

En genomgång av tentamensvakt på distans för kunskapsbedömningar

3002024148

Slutgiltig rapport, september 2022

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SAMMANDRAG

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Nyckelord

Ackreditering
Artificiell intelligens
Tentamenssäkerhet
Tentamensvakt på distans

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