

## Culturing Security System in Chemical Laboratory in Indonesia

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### ABSTRACT

Indonesia has experienced on the lack of chemical security such as a number of bombing terrors and hazardous chemicals found in food. Therefore, chemical security should be implemented to mitigate the misused of chemicals. The implementation of chemical security is a new thing for Indonesian citizens even though the introduction has conducted for years through training, seminars, and Government regulations. The evident is coming from the interviews conducted in this study. Questions asked in this interview/survey: the implementation of chemical safety and chemical security in the laboratory; chemical inventory system and its regulation; and training needed for chemical security implementation. Respondents who were basically researchers from Government research institute, university laboratories, senior high school laboratories, and service laboratories were still confused in distinguishing between chemical safety and chemical security. Because of this condition, there are many laboratories did not totally implement the best practices of chemical security. As conclusion, the Government needs to pay more attention to educate people who engage with chemicals to raise their awareness into chemical security best practices. Besides, the Government should optimise law and regulations and develop practical guidelines and standards for chemical safety and security to be applied to all chemical laboratories in Indonesia.

**Keywords:** chemical security; inventory system; chemical misused; awareness; chemical laboratory

### ABSTRAK

Indonesia telah mengalami beberapa kasus penyalahgunaan bahan kimia seperti teror ledakan bom dan penemuan bahan kimia berbahaya dalam makanan. Oleh karena itu, keamanan kimia merupakan faktor penting untuk mengurangi penyalahgunaan tersebut. Pelaksanaan keamanan kimia di Indonesia masih merupakan hal baru walaupun upaya pengenalannya sudah dilakukan melalui pelatihan, seminar, dan adanya peraturan pemerintah. Telah dilakukan studi kepada beberapa peneliti di lingkungan universitas, lembaga penelitian, laboratorium jasa, dan sekolah menengah atas untuk mengetahui tingkat pemahaman dan pengimplementasian budaya keamanan kimia di lingkungan kerja mereka. Pertanyaan yang diajukan dalam wawancara ini meliputi: pelaksanaan keselamatan dan keamanan kimia di laboratorium; prosedur inventarisasi bahan kimia dan peraturan pemerintah yang menyertainya; serta pelatihan yang dibutuhkan untuk melaksanakan sistem keamanan kimia. Dari data jawaban yang diperoleh, diketahui bahwa sebagian besar responden belum dapat membedakan antara sistem keselamatan kimia (chemical safety) dan keamanan kimia (chemical security). Oleh karena itu, banyak laboratorium kimia di Indonesia belum benar-benar menerapkan sistem keamanan kimia. Kesimpulan yang diperoleh dari hasil studi ini antara lain pemerintah perlu memperhatikan upaya peningkatan kesadaran masyarakat melalui: pendidikan, mengoptimalkan regulasi tentang keselamatan dan keamanan kimia, dan membuat guideline standar (buku pedoman) tentang pelaksanaan keselamatan dan keamanan kimia.

**Kata Kunci:** keamanan kimia; sistem inventarisasi; penyalahgunaan bahan kimia; kesadaran; laboratorium kimia

### INTRODUCTION

The chemical laboratory especially chemical research laboratory gives a central role in science. Understanding chemical principles is important in solution of many problems in associated disciplines, such as pharmacy and chemical industry. One of the key-success factors for chemical research throughout the world, including Indonesia, is the safety and security

of the chemicals being used. Chemical safety and security are two important areas in global security engagement efforts. The steps taken to enhance chemical safety and security must cover all stages in the life cycle of chemicals including control of production, storage, transport, handling and consumption, and end use of chemicals (tracking chemicals). Besides, monitoring people who have access to chemicals at every stage of research also

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can be a factor and should be highlighted in nurturing chemical security effort [1].

Culturing chemical safety and security will provide greater assurance that the national chemical security system can perform their function of preventing misuse of toxic chemicals (especially dual-use chemicals) by people who have malicious intention. Dual-use chemicals are chemicals that can be used for both legal and illegal purposes [2]. Moreover dual-use chemical and technologies have increased globally [3]. Indonesia that has many chemical laboratories should be vigilant against the misuse of dual-use chemicals. Possible security threats that may occur are: chemical theft to use chemicals as improvised chemical weapons/precursors and convert them into a weapon of mass effect; stealing of equipment or material resulting in release or explosion during transportation; and sabotage.

Indonesia has often experienced the terrors of bomb explosions since 1970s. The most famous, two sequences of Bali bombing I in 2002 and Bali Bombing II in 2005 had attention of the world community. After investigation, it turned out most of the bombs used were a homemade bombs consisting of a mixture of potassium chlorate, sulphur, and aluminium. Moreover, TNT (trinitrotoluene) was a favorite bomb ingredient to conduct these terrorist's attacks [4], and can be made from common chemicals like sulfuric acids, nitric acids, and toluene, which also are widely spread in the chemical laboratory in Indonesia. Also, methods to homemade synthesis of TNT are widely available [5]. Therefore, these chemicals should be kept secure to avoid the misuse of them. Establishing the awareness of people and culturing chemical security system could be the important ways to implement keeping these chemicals safe from people who have malicious intent.

However, developing a culture of safety and security can be a challenge. Social and cultural barriers can prevent laboratory managers, laboratory personnel, or other parties to use the best safety and security practices [6]. It is necessary to inculcate a culture security within the mind of people who operate and work in very different kinds of facilities, because the key to security is the human factor. Managing security in a chemical laboratory and university also give different challenges. It is very interesting because there are many kinds of chemicals, although they are in small quantities. In research laboratory, there are many scientists who have knowledge and curiosity to mix them up to create new compound and sometimes unaware of its potential danger.

Nowadays, there are several laws in Indonesia that control the chemical safety and security i.e. Law the Republic of Indonesia no. 9 Year of 2008 on the Use of Chemical Materials-and-the-Prohibition of Chemical Materials as Chemical Weapons and Law number 6 of

1998 of the Ratification of the Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons. However, practically (especially for chemical security) is not yet established in the culture of human being. They are very limited number of people who aware on them, despite the fact that chemical safety cannot exist without a chemical security culture.

This paper is focused on the observation of the implementation of security management based on the Indonesia regulation in the Chemical Laboratories in Indonesia. Furthermore, study also was directed at observing the level of consciousness of laboratory personnel because human factor is the main factor in the security sector. The study had conducted by directly surveying several chemical laboratories in Indonesia. The questions on the survey were made based on the key factors for achieving the desire security. The survey results were compared with the literatures and National/International regulation which explains the importance of the application of security to chemicals issues to prevent proliferation of chemical weapons. The survey results will be analyzed then looking for ways to solve the existing problem. The recommendations created by this field study hopefully will respond to the challenge of implementing effective security system in Indonesia.

## EXPERIMENTAL SECTION

This survey aims to gain information related to the implementation of chemicals security in Indonesia Chemical Laboratory. The idea to do survey rose because of problem questions: (i) Do people who are directly involved in the chemical laboratories consider on the latent threat of chemicals could be misused to harm people?; (ii) Have chemical laboratories in Indonesia implemented the concept of chemical security?; (iii) Do the Government's laws-and-regulations go far enough in controlling and instructing laboratories to apply chemical security in the chemical laboratories in Indonesia?; and (iv) What should be done to establish a culture supporting the implementation of chemical security in Indonesia?

### Steps toward Interview Session

Learnt on Indonesia's regulation for chemical security was the first step before developing points for interview questions. Points for questions were related to implementation of security system including plants security and chemical tracking (inventory system) in the laboratory. After making question points, the next step was collecting names of laboratories in Indonesia and sent out invitation to be interviewed through mail

message (email). There were 24 people who gave feedback to the mail message and agreed to be interviewed. They are laboratory personnel from government research institution, university laboratory, private service laboratory, and laboratory in the senior high school. The interview questions covered aspects of chemical safety and security. The survey questions were based on the following definitions of chemical safety and chemical security: chemical safety aims to protect individuals and the environment from potentially hazardous chemicals in chemical research, while chemical security aims to protect chemicals from theft and sabotage by people who have malicious intent. After interviewing respondents, the writer collected the data and analyzed it. The data presented in this paper reflects the aggregate responses from all those interviewed for a total of 24 direct respondents.

## RESULT AND DISCUSSION

### Summaries of Survey Data

Survey was addressed to four main chemical laboratories contain Government research institutes laboratories, university laboratories, senior high school laboratories, and private service laboratories. Consideration for choosing government research institutes laboratories is the activities of this laboratory should be very close with the regulation set up by the Government. Government research laboratories should lead in establishing a good management system in Indonesia laboratory. Total number and type of respondents are summarized in Fig. 1.

University labs are also a target of the survey for this research. Universities could be likely a key area of interest for terrorist because universities have diverse research works, and mostly are cutting-edge research, and with a strong and natural propensity towards intellectual freedom [7].

University keeps a latent threat could be misused by people who have malicious intent because the security at the plant facilities is quite weak. Besides, there are many students and lecturers use chemicals for their activities, therefore the regulation on chemical transfer should be very tight. University needs to record every step of chemical consumed.

Senior high school laboratory is the third target in this survey because their activities introduce students to the basic of chemical experiment. Because of the type of experiment is an introduction level and there is also numbers of students who still unfamiliar with the chemicals, therefore the observation of chemical handling is also important to be done.

Private laboratory especially service laboratory also plays an important role in chemical life cycles. There are

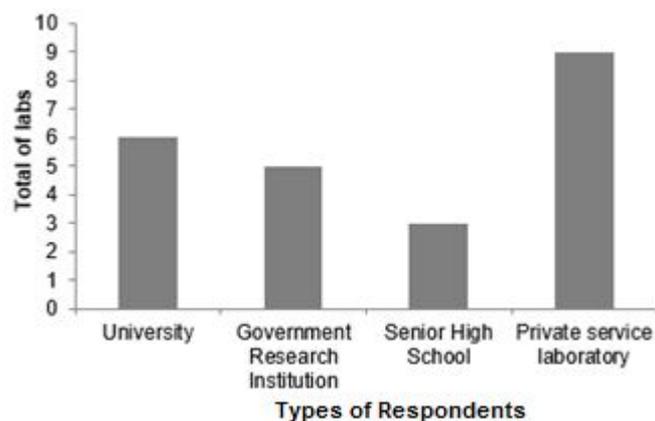


Fig 1. Total number and types of respondents

many researchers who cannot analysis target compounds in their samples, so that they send their samples in to service laboratory.

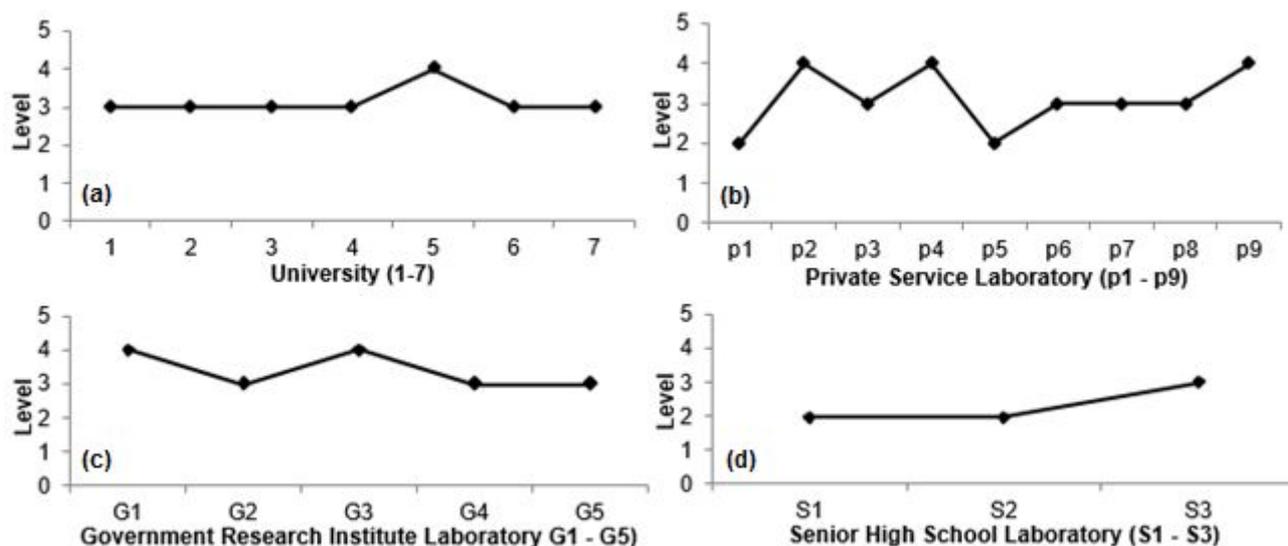
Indonesia has many chemical laboratories ranging from government research institutes, universities, senior high school, and service laboratories. Respondents came from government research laboratories and universities are selected regarding to their reputations. On the other hand, respondents from service laboratories and senior high schools were randomly selected. These 24 respondents were located at six universities, five government institution chemical laboratories, three senior high school laboratories, and nine service laboratories.

Questions highlighted in the questionnaire are related to: Laboratory condition in Indonesia, safety for laboratory personnel, safety for the chemicals (protection to the chemicals, including plant facilities), inventory system, regulation on chemical procurement, and necessity of chemical safety and security training).

### Laboratories condition in Indonesia

Regarding to the survey; there are various conditions of laboratories in Indonesia. Some laboratories have applied good management systems or good laboratory practices, but the rest are not performing at high enough level. Good laboratory practice is concerned with the organizational process and the conditions, under which laboratory studies are planned, performed, monitored, recorded, and reported [8]. Laboratories which have implemented good laboratories practices normally already have proper facilities and safety-and-health work. Proper facilities mentioned here are consisting of building and laboratory equipment such fume hood and instruments.

Fig. 2 provides description for each types of laboratory's condition in several chemical laboratories in Indonesia. Y axis describes the quantitative measurement indicate 1 to 5; 1 showing the worst



**Fig 2.** Level of laboratory condition in respondents: (a) universities, (b) private (service) companies, (c) government research institutes, and (d) senior high school

condition and 5 the best condition for laboratory. Best condition for laboratory means if laboratory already has very good construction for their building and good facility including equipment, management, and also instrument. Moderate condition describe the laboratory condition is already good in facility, but mostly still lack in numbers and variety of instrument. Most of the Indonesia laboratory (regarding to this survey) already have good management system and equipment, but there is still less on kind and numbers of instrument. Various research need kinds of instrument, but for laboratories which have less numbers of instruments, they usually send their sample to service laboratory to analyze their sample.

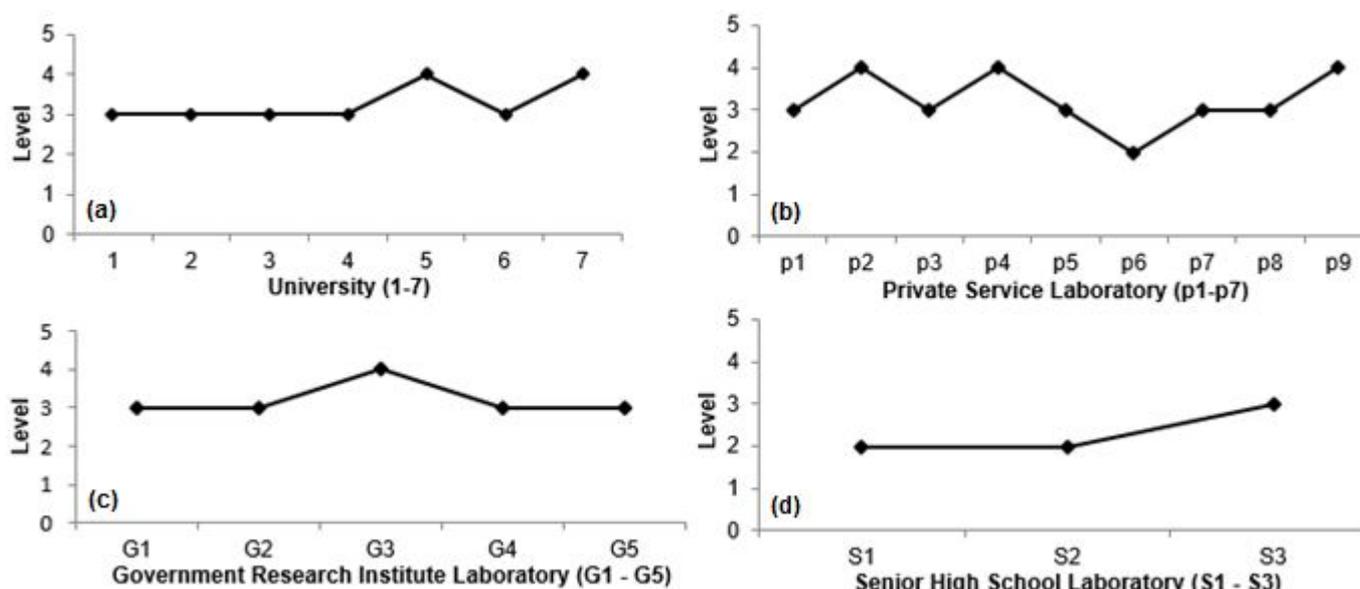
For specific, chemical laboratories in Universities mostly have moderate conditions. Their building and facilities have met good safety standards laboratories. They have also fume hood, exhaust to permeate chemicals smoke, and provide separate room for instruments. However, there are weakness on limited types and numbers of instrument to accommodate researchers' activities. However, there is one laboratory which has point "4", because this laboratory has more variety on instrument, but user still have a bit problem with the laboratory equipment like beaker glass.

Chemical laboratories in Government Institution have higher moderate conditions than laboratory in University. In contrast, senior high school chemical laboratory condition is in poor categories. The proper reason for senior high school is the laboratory activity they do commonly is an introduction for chemical experiment; therefore they do not need a sophisticated instrument and specific building for their laboratory.

Service laboratories have variety rating for their laboratory conditions. Some of them have very good quality and the rest are not. The whole condition of service laboratories (mostly private company) depends on their owner fund. Laboratories which are not yet have good laboratory conditions, mostly because of their facilities (i.e. chemicals cabinets, fume hood) have broken and laboratory building is not enough feasible to do research or chemical analysis. Laboratory conditions should be noted by laboratory personnel, management, and also the Government to acquire great research and chemical analysis.

#### **Safety for personnel laboratory**

Safety is addressed to protect worker (researcher and technicians) from the chemical hazards. Laboratory personnel in Indonesia mostly have implemented safety best practices by using personal protective equipment (PPE) such as: gloves, masker, and laboratory clothes during their work in the laboratory. However, there are several respondents said that the implementation of chemical safety best practice are still on going. It means that actually it not been fully implemented yet. Laboratory which yet implemented this safety came from several university students, government research laboratories, and mostly senior high school laboratories. The reasons they have not implemented are because of the limited of knowledge, funds, and underestimate to the chemical hazards. This non-uniform of implementing safety system in chemical laboratory showed in Fig. 3. There are various levels on implementation of safety system by different laboratories. Laboratories that



**Fig 3.** Level of safety practice in universities (a), private (service) companies (b), government research institutes (c), and senior high school (d)

occupy high level (level 4) means that they have been applied safety procedure during their work, but sometimes they are lacking on wearing PPE. Laboratories that take place on level 3 means they have moderate level. Sometimes, these laboratory personnel lack on wearing PPE because they underestimate the chemical hazard. Laboratories that state level 2 mean this laboratory has poor equipment to support the implementation of safety procedure.

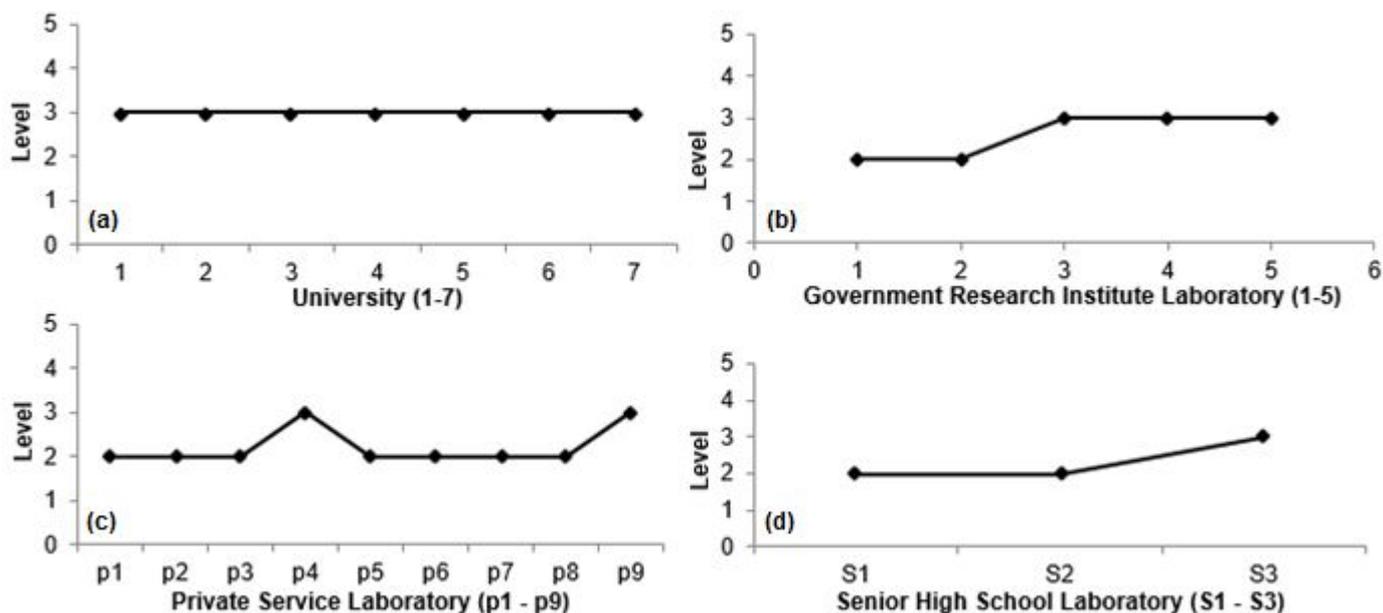
#### **Safety for the chemicals (protection to the chemicals - chemical security)**

Facilities to protect the chemicals are not fully implemented in Indonesia chemical laboratories. The limited consideration on potential threats is the main point of view should be emphasized to the mindset of laboratory personnel and their management. Potential threat and risk such as chemical stolen by people have malicious intent should be highlighted and embed into training program to laboratory personnel in Indonesia.

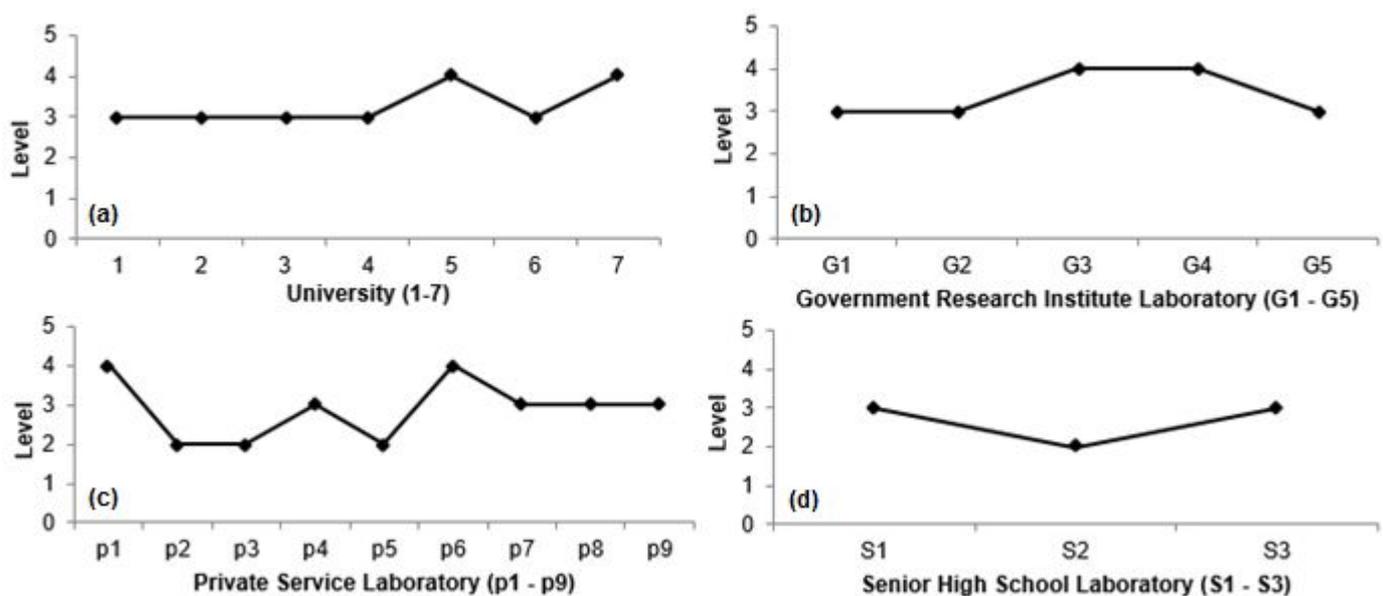
Fig. 4 describes the level of implementation of security system in chemical laboratory. The level is coming up from the lowest level (zero) to the highest level (level 5). Low level means that the laboratory is yet apply security system to their laboratory. Whereas high level means that the laboratory already implements security system for their laboratory. Security system in this case is covering plant security. Regarding to Fig. 4, only laboratories in university and several government research institutions have moderate value in implementing chemical security. Mostly universities have been trying to keep their chemicals secure. They keep their chemicals in locked cabinet and in restricted

access. However, restricted access they mean actually is different with special room which protected by any additional guard. There is area which student cannot entrance. However, there is still no other protection like layer locked and badges. Moreover, university is big building which always opens during the weekend and sometimes there are rare people inside the building. This condition is also risking if there are no more plant security to enter the building.

Consecutive among service laboratory, government institute laboratory, and senior high school laboratory are yet completely implement the chemical security best practices. Mostly they have no locked cabinets for their chemicals. Although there are numbers of private companies (service laboratory) and government institutions have been set-up provision to whom may enter their office, but there could be a risk if their chemicals are not secured since there are numbers of hazardous chemicals (i.e. standards of pesticides, standards of precursor chemical schedule 2-and-3) are available in small-scale container. Either insider or outsider who permitted to entrance the building could steal the chemicals if there is no security like locked cabinets and regular inventory system. Regarding to the survey data, service laboratory have low security level categories because there are numbers of outsider (customers) who can enter the office and probably they can also see laboratory condition. This is risk if the chemicals is not been secured by the management. Management and laboratory personnel should be on alert to every particular threat related to their chemicals. Regarding to the point number 2 and 3, the Government should



**Fig 4.** Level of security practice in universities (a), private (service) companies (b), government research institutes (c), and senior high school (d)



**Fig 5.** Level of inventory system in universities (a), private (service) companies (b), government research institutes (c), and senior high school (d)

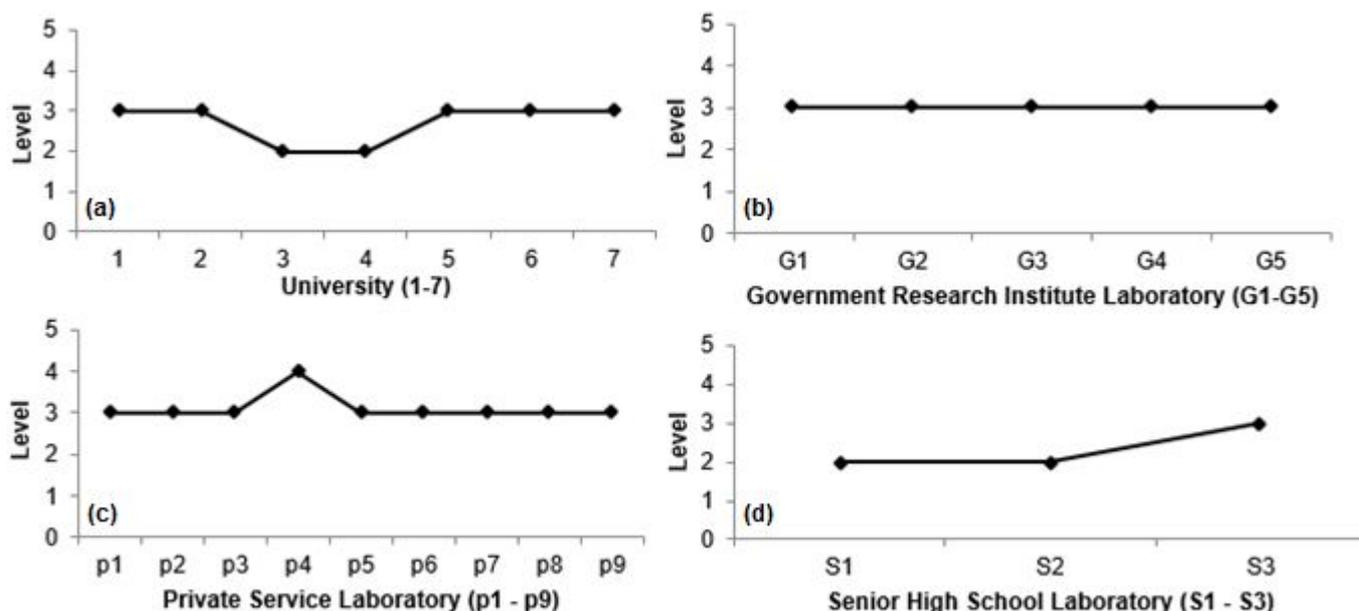
pay more attention to establish culture on the practical of chemical safety and security.

#### **Inventory system**

In this survey, inventory means record of the chemicals used but it should actually cover every chemical stages (chemical life cycle) start from purchasing, storing, using, and waste disposing. Inventory system should be highlighted by laboratory personnel to trace the chemical consumed. Notification

and record in every particular stages of the chemicals life cycle are the important ways to oversee the chemicals life cycle.

Fig. 5 describes the level of implementation of inventory system in chemical laboratory. The level is coming up from the lowest level (zero) to the highest level (level 5). Regarding this survey, there are laboratories which maintain their inventory monthly; there are also laboratories which maintain their inventory every two weeks. Several big laboratories



**Fig 6.** Level of user satisfaction within regulation in universities (a), private (service) companies (b), government research institutes (c), and senior high school (d)

have their own divisions to maintain their inventory system. For examples, they have a division on the chemical procurement, storage, and user (researchers). This management is good. But, not all laboratories apply this system. Sometimes, researcher who authorized to maintain inventory of storing and using of their chemicals, have been lacking in maintaining this steps. Sometimes, laboratory personnel do not record the numbers of chemical out because they claimed that the numbers they used are in small quantities. There is a case if laboratory personnel do not note the chemical which have consumed. It could be "hole" if there is malevolent people (insider) utilize this opportunity to steal numbers of chemicals. In short, their management will note the chemicals that coming in and out from the chemical procurement. But in the second stage, when the chemicals already kept by the user, sometimes, the user did not note numbers of chemicals they used. The lack of uniformity in implementing this kind of inventory system should be addressed to the better way.

Fig. 5 shows that universities and government research institutes have moderate level in applying inventory system. The moderate level is only the average value. Even universities and government research institutes have the same rate (moderate rate), but somehow, their application in implementing inventory management system have differences as mentioned above. Sometimes, they are strict in protecting their plant facility (to enter the office) but they have not applied plant security for their chemicals in their laboratory. Service laboratory have variety of level on displaying their inventory system. Several laboratories

are very active noted every particular chemical cycle activities they did, but not for the rest laboratories.

#### **Regulation on chemical procurement**

Indonesia has been tight and strict on the procurement of chemicals, especially for schedule chemicals and the precursor. Schedule chemicals are chemicals that either can be used as chemical weapons themselves or used in manufacture of chemical weapons. Organization for the Prohibition of Chemical Weapon (OPCW) classified Schedule of Chemicals into chemical schedule 1, schedule 2, schedule 3, and its precursors [9]. Precursor is a compound that participates in the chemical reaction producing another compound-and/or-chemical weapon. Indonesia has numbers of laws and regulations which regulate security on chemical procurement. Research institutions should attach letter of permission from the Indonesia National Authority for Chemical Weapon Convention (CWC) to purchase schedule chemical for research purposes. Also, the procurement of precursor reagent like sulfuric acid and chloric acid need to enclose an end-use certificate.

Implementation of the chemical procurement in Indonesia is getting better to support regulations which avoid the abuse of the chemicals. But, the awareness of people in maintain their chemical secure is not applied well. The evidence is there is still limited numbers of chemical laboratory which keep their facilities secure to protect their chemicals. Moreover, only limited numbers of laboratory personnel who know

what security is and the threat could happen to their chemicals.

Fig. 6 describes the level of user satisfaction to the Government regulations. Depends on the survey result, there are respondents who complain about the strict of the regulations. Several respondents from governmental institute laboratory recommend about rearrangement of the regulation related to procurement of the hazardous chemicals. One respondent totally understands Government applies that rules. But, he suggests Government to readjust their regulation to give an exception or concession to chemical procurement which totally used for research purposes.

Research is one of fundamental factors to support National economic growth. The Government should also understand and sustain what the researcher needed. The Government could give alternatives, such as: reduce the regulation tight for researcher; and Government should facilitate a funding support to build security system for researcher's laboratory. Also, researcher should obey every particular step to fulfill security procedure to keep their chemical secure. Sit and discuss together among researcher representatives, Government representatives, and security experts could be the best solutions to solve this issue.

#### **Training on "chemical safety and security"**

Most interviewed respondents have attended chemical safety training or workshop, but only a limited number have attended workshop on chemical security. Actually, there are numbers of seminars, workshops, and trainings have conducted by the Indonesia Government in collaboration with Australia Government and US Department of State – US Chemical Security Engagement Program (US-CSP). In contrast, only one of respondent and their colleagues attended the security workshop. There are issues because Indonesia has wide area, big populations, and big number of chemicals laboratories. Therefore, it needs times to accommodate spreading of dissemination related to chemical security.

#### **Indonesian Regulations Related to Hazardous Chemicals and Combat Terrorism**

Laboratory personnel should consider to the latent threat of chemicals since terrorist likely use common chemicals to create their own homemade explosive bombs. Therefore, the security of the chemicals laboratory should be applied to avoid the misuse of chemicals. The consequences of the blast chemicals bomb, even not as big as nuclear weapon attack, would be adverse because of the people killed and wounded. People should consider on humanitarian aspect related attacking issues including bombing or chemical weapon issues.

Indonesia has Laws and Regulations to combat chemical terrorism including Law no 15 year 2003 on Countering Terrorism. On October 22, 2002, President Megawati Soekarnoputri signed Indonesia's Anti-Terrorism Law of 2002 namely Interim Law No 1 of 2002 on the eradication of crime of terrorism, six days after Bali Bomb I took place. Then, the DPR (Dewan Perwakilan Rakyat/Indonesia Parliament) adopted Interim Law No 1 of 2002 at its next sitting through Law No 15 of 2003. This Law mentioned to Counter Terrorism which covers such crimes as using Chemicals, Biological, and Radioactive substances for terrorist purposes [10]. Besides respond to the National Terrorism accident, this law also supports United Nation Security Council 1540 on Determined to combat by all means threats to International peace and security caused by terrorist acts.

After Bali Bomb incident and ratified of Law number 15 year 2003, Indonesia still has problem on bombing terror such as bombing of the Marriot Hotel in Jakarta on August 2003, behind the United Nation office in Jakarta and Cengkareng International Airport in 2003, the Australian Embassy in Jakarta in September 2004, and the second round of Bali Bombing in October 2005. Besides, Indonesia got also several small bombing terrors in their several areas such as Poso, center of Sulawesi [11]. It was estimated that an improvised explosive mixture with an estimated power equivalent of 150 kg of TNT had been used. When arrested the offenders states that the bombs were made from a mixture of potassium chlorate, sulphur, and aluminum, boosted by TNT [4]. In addition, the mixture of potassium chlorate, sulphur, and aluminium powder is classified as a flash powder that is widely used in industrial fireworks, firecrackers, matches which usually produce an explosion of light and the explosion is usually weak or low power. However, if it is designed with certain formulations and use strong-and-narrow containers (confined) then this mixture can detonated, so that these materials can be classified as a high explosive chemical [12]. Organic explosives such as TNT, PETN, and RDX are characterized by high velocities of detonation (up to 9,000 m/s) and have application in detonators, boosting chargers and military ordinance [13].

Indonesia has also several regulations related to managerial laboratory system either in chemical laboratory or chemical industry for examples: Decree of Mol (Ministry of Industry) No 148/1985 about Safety Management of Toxic and Hazardous Substance in Industrial Company; Decree of Mol no 24/2006 about Supervision on Production and Use of Hazardous Material for Industry; Mol and MoT No 04/2006 about distribution and control on hazardous chemicals; Mol and MoT No 44/2009 about Procurement, Distribution,

and Supervision of Hazardous Materials; MoA (Ministry of Agriculture) No 7/1973 on Supervision of Distribution, storage, and usage of Pesticide; Indonesia regulation No 74/2001 on Hazardous Substance Management; Ministry Decree No 03 year 2008 for providing symbol and label on Hazard and Toxic substance; etc.

In 2008, Indonesia President, Susilo Bambang Yudoyono signed Law number 9 year 2008 on the Use of Chemical materials and the Prohibition of Chemical Material as Chemical Weapon. This Law also covers the implementation of CWC for Indonesia as an active OPWC member. This law regulates the use of the chemicals and the prohibition of the use of chemicals as chemical weapon and will pay attention to the principle of safety, security, use, and its balance. This law also mentions all chemicals which have potential to be misused such as OPCW chemical schedule 1, 2, 3, and DOC (District Organic Chemicals). This law also mention about establishment of Indonesia National Authority who will become an intermediary between the Indonesia Government and International Organization and/or State Parties. Indonesia has National Authority which oversees activities especially related to three schedules of chemicals and chemical of concern (CoC). Indonesia National Authority does their responsibilities to be intermediary between Indonesia Government and OPCW. This law also explains the punishment for violation of its regulation. Before this Law, Indonesia had issued Law no 6/1998 about ratification of the Convention on The Prohibition of the Development, Production, Stockpiling and use of Chemical Weapon and their destruction.

Recently, activities to support regulation which avoid the abuse of the chemical are getting better. Several regulations have been implemented in the chemical cycle activities in Indonesia such as for purchasing chemical schedule and their precursor. People or institutions should attached letter of permission from the Indonesia National Authorities. Also, the procurement of precursor reagent like sulfuric acid and chloric acid need to enclose end-use certificate. This end-use certificate describes that the chemicals bought by institution is totally for doing research and not to be re-sell or gave to other people illegally. These tight rules and regulations are perceived by respondents interviewed in this research survey.

Indonesia has done quite a lot in terms of regulations, but still needs to improve and updated [14]. Nowadays, Indonesia is in process on drafting new Law on Chemicals. The cores of the regulation are about chemical life cycle, science hazard-risk based management and chemical safety and security. The Indonesia new bill will encompass [14]: references of existing regulations for chemicals in Indonesia; the core of bill is hazard-risk science based management and

chemical safety and security; the scope of chemical life cycle; and classification, labeling and safety data sheet, based on globally harmonized system (GHS).

### Notes from Survey Research Activity

Based on the survey data about Government regulations, Indonesia needs harmonization among existing regulations on chemical management in Indonesia. There are numbers of complaints from most researchers related to these rules especially for chemical procurement. The foremost reason is because those people still lack knowledge about the important of implementing those regulations to protect or maintain chemical transfers. There are steps that could be taken by the Government to embed basic knowledge related to chemical security implementation. The steps consist of optimizing law and regulations, educating people (laboratory personnel and their management), and also making guideline practical standards related to applying chemical security in laboratory.

The Government should ensure that chemical user (in this case are researchers or laboratory personnel, not only chemical industry) are aware to the need of protecting their chemicals. Chemical user should obey and follow Government regulation and implementing guideline practical standards. Besides, the Government should also consider about supporting researcher on their research. The Government and researcher could sit together to figure out the best way to solve this intersection issue.

According to survey data, there are indications that there is confusion or misunderstanding between chemical safety and chemical security. One of the questions asked is about respondent's reason in protecting their chemicals. Mostly respondent answered the questions from the safety perspectives. Several statements they gave: (i) "The main reason protects our chemicals secure because there will be a risk if chemicals are not handled in the right way, it will be harming people/researchers who working with. Also, mishandling chemicals could make invalid data for measurement"; (ii) "to avoid work accident"; (iii) "to protect environment from the chemical pollution"; (iv) "to protect chemicals from contamination"; (v) "protection on chemicals means to prevent laboratory from fire (protecting explosive and flammable chemicals)".

There are only a few respondents who consider security aspect, such as those who gave statements: "chemicals should be protected to avoid abuse on its handling". Moreover, most respondents are not familiar with the term of "dual-use chemicals" even they work regularly with dual-use materials and dual-use

technology. Dual-use chemicals which commonly available even in small chemical laboratory are sulfuric acid and hydrochloric acid. These chemicals could be an ingredient to make a chemical bomb or drug precursor (reagent) [15].

During survey discussion, respondents requested for comprehensive training related to chemical security for academia and technical laboratory manager.

There were numbers of workshop and seminar conducted in several points in Indonesia, but, it will take time to spread this education. The respondents interviewed for this survey consist of people spread in Java and Kalimantan Islands. That means that conducting workshop, seminar, and training is very important but it is not the easy way to create culture of implementation of chemical security in the short time. It takes long time to embed knowledge and understanding in people about the important of implementation of the chemical security. Besides, it seems very abstract if there is only a short seminar or workshop of a few days without any further direct practical implementation.

Therefore, we indeed need a clear set of guidelines that are practical standards related steps taken to establish chemical security best practices. Guideline standard can help to harmonized technical specification to security practice. Moreover, regarding to data survey gave from this research, there are non-uniformity data on implementing both chemical safety and security in Indonesia chemical laboratory. Collaboration among International Union of Pure and Applied Chemistry, International year of Chemistry, and The Academy of Science for the Developing World (TWAS) creates an "Instructor's Guide, Form, and Sign to Prudent Chemical Management: Chemical Laboratory safety and security" [6,16]. There are several guides covered: guides and practical lesson to improve laboratory safety and security follow up on suspicious behavior, inventory log, emergency preparedness plan for working with a chemicals, and laboratory hazard assessment checklist.

In summary, the guideline practical standard should consist on points related to: program management, inventory system, risk assessment, reporting any suspicious activities and plant security. The structure of management to manage chemical life cycle from purchasing, using, through disposing wastes should be highlighted. Management who are responsible to the Inventory system should make a list of chemicals to control if something is missing or moved. In addition, laboratory management should identify the possible threat might be happened in chemical laboratory related to the non-state actor menace. Threat could come from both outsider and insider. Outsider could be form as theft, while the examples of the insiders are visiting scientist, students, and workers. Management should also consider if insiders could conspire with outsiders to

steal chemicals from laboratory stock. Indonesia Government, by this standard, should highlight laboratory personnel to report any suspicious activity. Laboratory should have clear guidelines in place of *suspicious activities* that should make a call to the authorities such us (could adopt from the FBI guidelines [17]): unfamiliar people who walk around laboratories several times without any particular reasons; missing supplies, chemicals, or equipment; request to borrow chemicals or equipment from unidentified individuals; unsolicited requests for technical information; if there is any chemical purchases charged to the laboratory but never delivered; and if there is any unsolicited delivered to the lab without a corresponding purchase or numbers of chemicals delivered is more than numbers of chemical ordered).

Plant security, however, is also very important. Building and managing plant security should be very clear in written form in this standard (i.e. There should be cabinet locked for every particular chemical especially for dual-use items). In addition, safety and security training for laboratory personnel is very important to reach balance safety and security laboratory. Researcher and other laboratory personnel should understand how to make them safe during their work and they should also know how-and-why they should protect their dual-use chemicals securely.

Sometimes, waste that contains hazardous chemicals could be misused by malevolent people if unprotected. Therefore, the standard could also highlight the waste security. In another case, for private companies which selling chemicals, monitoring every suspicious transaction should be addressed. There is also restriction or limitation on selling chemicals especially to people who could not show their legal identity and activity. Guidelines should also mentions characteristic and what the employee should do to avoid misuse of chemicals during transfer [18]. Employee should be very well trained on particular chemicals they sell and must be aware of people/customer who [19]: are vague or unable to answer simple questions about products they intent to buy; customer who have unusual preoccupation with certain products chemical composition; people who are new or unknown customer; customer who seems unwilling to show valid identification – while seller should write detail of transaction consist of what time it was, what he/she bought, identity (name, physical description, license plate, and phone number); customer who offer large cash purchase or using someone else credit card; and customer who buy strange quantities of chemical.

Indonesia could also adopt steps of other several international standards to make their own national

standards on chemical safety and security. Standards available i.e. are ISO 140001:2004 that is applicable to organization that wishes to establish, implement, maintain, and improve an environmental management system and to assure itself of conformity to the environmental policy [20]; OHSAS 18001 is an International occupation health and safety management system specification [21]; United Nation-Globally Harmonized System that is a system defines and classifies the hazards of chemical products, and communicates health and safety information on label and material safety data sheets [22-23]; Strategic Approach to International Chemical Management that is a framework to maintain the sound management of chemicals [24-25]; and International Small Arms Control Standards is a standard which provide guidance on the control of small arms and light weapons [26].

Verification and monitoring from the Indonesia Government is needed to ensure that Indonesia chemical laboratory are implement standards and regulations. Inadequate controls, for example in the inventory system and control by practice, may result in proliferation and terrorism consequences. The primary aims of controls (adopted from International Small arms control standards) [27] are to prevent illicit manufacturing of chemicals and chemical weapon, their essential components and their ammunition; to ensure that all chemicals are marked and recorded at the time of manufacture and transfer so that they can be traced to their point of diversion if recovered under illicit circumstances; and to prevent theft and loss of chemicals from manufacturers' stocks by requiring adequate security and recordkeeping at manufacturing premises.

## CONCLUSION AND FUTURE RECOMMENDATION

Based on survey data, laboratory conditions mostly have been implemented chemical safety and good condition for chemical laboratory. But in the term of security, there is still confusion between safety and security understanding. Because of this condition, most Indonesian chemical laboratories did not totally implement chemical security system. Education is very important step to address this problem. Laboratory personnel should understand why they have to protect their chemicals. Law and regulations should be sustained by all laboratory personnel activities to avoid chemical diversion to be used as weapons. The Indonesia Government could conduct workshops, seminars, and trainings to make sure that all laboratory personnel know the important of implementing chemical security. The Indonesia Government could also build practical guidelines and standards to be applied to all chemical laboratories in Indonesia. Legislation and

guidelines standards aim to ensure that the dual use chemicals are not be misused for chemical weapons, and can stop commercially available toxic chemicals getting into the wrong hands.

Co-operation among Indonesia Government, laboratory personnel, and security expert is very important to balance between doing chemical research activities and keeping chemicals secure. Culturing implementation of chemical security also is an important recommendation of this study. If all chemical laboratories already implement standards and obey regulations, it means that culture has been created and then it is important to sustain effort to obstruct malicious act.

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