Military liquidators in liquidation of the consequences of Chornobyl NPP accident: myths and realities

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Twenty years have passed after the Chornobyl accident, but its consequences are so immense that even now some facts are still not sufficiently investigated and being a subject for analysis by specialists on radiation protection and emergency response. In this article we will present the available information and our considerations concerning advisability and results of many thousands of military contingents that were involved in liquidation of the Chornobyl NPP accident consequences (LAC).

Some historical information on military involvement into LAC works

Since 1986 the participants of LAC mission were termed "liquidators" in abbreviation form. Then this expression migrated to mass-media and later on to scientific publications. Military liquidators mustered from reserve sometimes are termed "partisans". Overwhelming majority of liquidators was comprised of such "partisans".

When the Chornobyl accident happened in 1986, the National (State) system of prevention and response for man-caused emergency situations was not established in USSR [1]. Independently establishments and departments formed response systems for emergency conditions at their best.

Missile Forces of strategic destination and Naval Forces armed by nuclear armaments and defence technology with transport nuclear power units had object and territorial systems of prevention and response for emergency. But these classes of Military Forces (MF) were not involved in liquidation of Chornobyl NPP accident consequences.

In case of a crash of spacecraft with nuclear power unit, a system was planned to be organised on a scale of all MF. 122 mobile detachment of special destination subordinated to Armed Forces General Staff (Headquarters) and extraordinary joint detachments, formed from chemical, radiation and biological defence units in each territorial command and Naval Forces, would be involved in this system.

It was cosidered that MF, including units of Civil Defence (CD), which were subordinated to Ministry of Defence at the time of accident, were technically, organisationally and psychologically ready for operation in conditions of nuclear war. These circumstenses and high mobilisation abilities of MF made themselves involving into emergency works from the first hours after the Chornobyl accident.

In the afternoon of April 26 the first mobile group of Kyiv Civil Defence regiment arrived at the accident site. By the order of Commander of General Staff (Headquarters) of Military Forces, 122 mobile detachment of special destination from the region of Volga River and an extraordinary joint chemical detachment of Kyiv command began to relocate to the ChNPP accident area in the morning of April 27. Those were forces assigned and trained for liquidation of crash consequences of aircraft with nuclear power unit on board.

On April 27 the Air Forces helicopters became to perform reconnaissance flights around ChNPP with the aim of radiation survey and working-off the means for dropping loads into the reactor core. Local (civilian) population together with military personnel of the garrison 'Chornobyl-2' that was deployed at 10 kilometers to the south-west from ChNPP long before the catastrophe were involved in loading the helicopters with sand and other materials. Chemical service of this garrison performed in the morning

April 26 (5.00 – 10.30 a.m.) the first radiation survey along the road Chornobyl – Prypyat, inside the city Prypyat, the river harbor, the railstation and around the industrial base of ChNPP and destroyed reactor.

From April 29 the loading of the helicopters were performed by detached battalion of civil defense special protection. Military medical subdivisions provide medical assistance to the population who were evacuated from the 30-km zone from the very beginning.

From the very beginning after the accident, Military units were engaged in implemetation of the most urgent, difficult and dangerous measures on the site. However, later on the governmental leadership began to task irresponsible and absolutely impossible missions of decontamination of the 30-km zone (including Prypyat town) and re-evacuation by early 1987 of the evacuated inhabitants . It caused the commitment of many thousands military contingent to the zone of radioactive contamination. Fig.1 illustrates the dynamics of the cumulative number of military liquidators and the strength of Chornobyl Forces overall the period of MF participation in consequences liquidation.

By the middle of August 1986, the strength of the Chornobyl military contingent amounted to 40 thousand persons. But, considering the unfeasibility of decontamination of settlements located in the 30-km zone, the quick withdrawal of forces from the accident site has begun. By the end of 1986 the number was reduced to a half. During 8 months of 1986, about 100 thousand military took part in LAC.

During 1987, the quantity of soldiers continued to decrease and at the end of the year it was about 13 thousand. The total number of military involved this year mounted to 120 thousands. Next year in 1988, the quantity of Chornobyl contingent went up to 20 thousands and during the year the overall number of liquidators was about 80 thousands.

Mobilisation of large-scale army contingent to LAC was due both to the large scale of tasks posed to MF and predominance of manual labor along with required promptness in liquidation actions. The construction of the protective fence around the 30-km zone was a striking example. This fence of 200 km length was set in 13 days only (from 8.06 till 20.06.86), which involved 7.3 thousand military for hard manual work [3]. But, according to the opinion of specialists, this work could be done by 5 times less military personell if it had been better planned and provided with necessary equipment.

In general, MF were charged withn the following tasks:

- covering of crater of the destroyed power-unit (reactor);

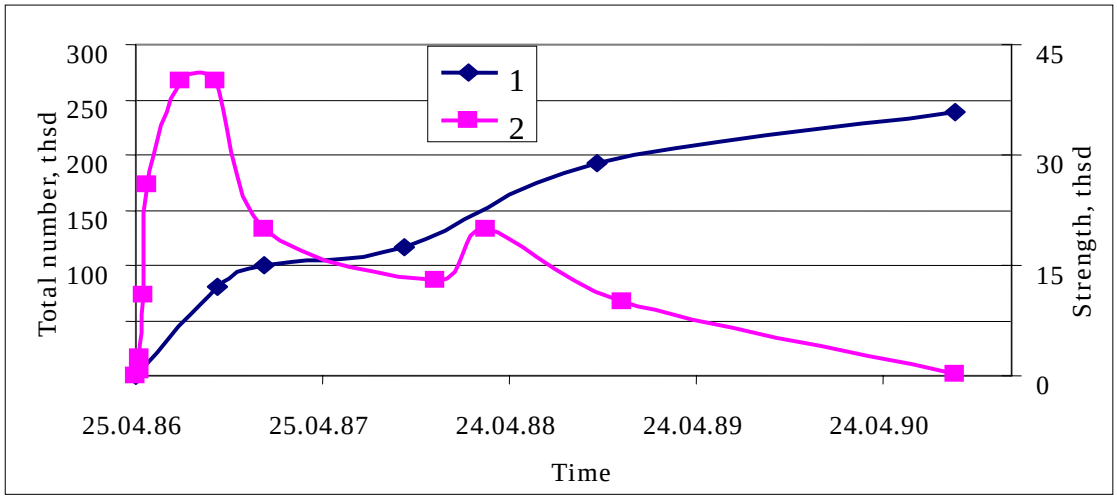

Fig. 1. Dynamics of the total number (cumulative total) of military liquidators (1) and strength of Chornobyl forces (2) during the period of military forces participation in LAC.

- continious radiation survey;
- decontamination of industrial area and NPP premises;
- decontamination of settlements, roads;
- special treatment (decontamination) of the vehicles;
- fencing in the exclusion zone;
- provision of the industrial zone functioning (concrete-mixing plants, communications, loading/unloading works);
- construction of water-protective structures;
- construction of radioactive waste disposal and temporary storage places for debris of destroyed reactor and other radioactive wastes, etc.

According to official data, the total amount of military liquidators during all the period of LAC amounted to 239.3 thousands [2]. Reservists ("partisans") formed the absolute majority, and the number of other personnel amounted to 17 thousands only, including career servicemen and soldiers of service for the fixed period. As a matter of fact, the absolute majority of military liquidators were not military men. They were civilians dressed in military uniform, who were neither physically nor mentally prepared to adequately tackle LAC missions. Some of them, especially in the initial period of LAC works, were deployed in the Chornobyl zone without special training, others were trained for a short time. But neither mustered reservists, nor their trainers could imagine real situation in the Chornobyl zone before being there.

The substantial problem for military subdivisions during the first weeks after the catastrophe was the rapid increase of their number under the condition of constantly changing radiation situation. Consequently, some military units found themselved in areas with gamma-ray dose rate of 50 mRh/h and higher. In search of cleaner areas, some units changed their dislocation up to three times – a major physical and psychological challenge for the servicemen in addition to their unjustified exposure to radiation.

The % fraction of the strength of different branches and provision units of Chornobyl forces is presented in Table 1.

Table 1.

The % fraction of the strength of different branches and provision units of Chornobyl forces.

Subdivisions of MF branches and provision units in Chornobyl forces	**Proportion, %**
Chemical	40 – 44
Engineers	28 – 32
Civil defence	6 – 8
Rear forces	6 - 10
Technical provision	7 - 9
Administration and others	4 - 6

Arrangements for military liquidators dose control.

Already since the first days following the Chernobyl NPP accident, it became evident, that MD Order № 285 dated 08.12.1983 [4] merely outlines a system of radiological protection of military men and dosimetric monitoring in case of radiation emergencies. For such a system to function effectively, dozens of regulatory and guidance documents had to be prepared and a wide range of arrangements made.

The unprecedented scale of the Chernobyl Disaster, difficulties in forecasting the scope of work to mitigate its consequences were the main reason for a debate within General Staff between the Military

Medicine Service Command, who insisted on setting peacetime norms (25 rem), and the Head of the Radiation, Chemical Biological Protection Department, who proposed wartime personnel exposure norms (50 rem) as the basis [2, 5].

However, even with such an uncertainty in exposure limits in the first post-accident days, Radiological Protection Service (RPS) and Dosimetric Monitoring (DM) within the LAC units did function. Thus, the KMD Air Force Commander – 1 May 1986 [6], and later on the KMD Commander– 4 May 1986 [7] issue orders on RPS arrangements in the subordinate military units involved in LAC. These orders establish exposure limits for military servicemen throughout LAC: 24 rem for Air Force servicemen and 25 rem for the rest of military liquidators.

Therefore, RPS including DM, was organized within all units arriving at the wrecked ChNPP area and getting under command by the KMD Force Commander already since the first days of their stay in the accident area. It is primarily indicated by the high level of provision of military liquidators with dosimetric monitoring data during that period in the State Chernobyl Registry [8].

It is worth mentioning, however, that the first post-accident activities of the military radiological protection services did not catch up with the situation as it developed, and regulatory requirements were not fully met. Particularly, already as of 1 May 1986 (issue date of the KMD Air Force Commander Order), the strength of units involved in the accident area activities almost reached 600 persons, including up to 100 representatives of KMD Air Force units, and as of 4 May (issue date of the KMD Commander Order) it was already a multi-thousand military contingent that participated in the emergency activities. In violation of i. 35 of MD Order № 285 dated 08.12.1983 [4] personnel were involved in ACL without orders authorizing work under high exposure doses, the first order of this kind was only issued on 1 May.

The permissible dose limit debate lingered until 21 May 1986. The normative uncertainty with respect to external exposure doses resulted during the first post-accident weeks in the exposure of 52 servicemen of Special-Purpose Chemical Force Unit 122 directly subordinated to Department Head of the RCB Protection Force, to doses of up to 72 rem [2, 9]. Meanwhile, the personnel of the military units subordinated to KMD, who carried out radiation reconnaissance missions of comparable radiological hazard or even more hazardous ones (flights over the wrecked unit), were exposed to much lower doses (Table 2). This Table demonstrates a dependence of the average military liquidator dose during the first month of liquidation activities on the set dose limits.

Table 2.

Doses of radiation to military units staff members participated in LAC in April-May 1986

№	Units	Sample size, persons	Dose limits, Rem	Confines of dose intervals, Rem		Average dose, Rem
				Min	max	
1	Chemical Force Unit 122	38	50	40	72	54.2±1.3
2	KMD Consolidated Chemical Unit	25	25	25	30.9	26.7±0.2
3	KMD Air Force	31	24	13.5	29	21.6±0.4

The permissible dose limit uncertainty was ended by MD Order №110 dated 21 May 1986 [10], which set the dose limit for all military servicemen at 25 rem. Item 3 of this Order provides for using "group" and estimated "group" dose assessment methods along with individual dosimetry. In addition, the permissible daily dose of 2 R [11] is introduced to prevent mass exposure of liquidators to major doses in the accident area. This measure made it virtually impossible to use common military dosimetry equipment to monitor exposure doses of military liquidators (Table 3).

Table 3.

Precise characteristics of domestic common military dosimetry equipment

№ за/п	Type	Range of measurement	Possibility of automated reading of data
Means of military dosimetric control			
1	ИД – I (ID-I)	20 - 500 rem	absent
2	ДКП - 50 А (DKP-50A)	2 - 50 R	absent
Means of individual dosimetric control			
3	ДК - 0,2 (DK-0.2)	10 - 200 mR	absent
4	ИД- II (ID-II)	10 – 1500 rem	absent
5	ДП - 70 М (DP-70M)	50 - 800 R	absent

In addition, another 30 various regulatory and guidance documents were developed [12, 13, 14], which detailed specific provisions for radiological protection of military liquidators.

In spite of all instructions for implementation of individual dosymetric control in liquidators units with the use of individual dosimeters, such kind of control was not implemented. Thus the group method (one individual dosimeter in a group) and group-calculated method (dose evaluation is made for military group taking in account the dose rate of gamma-ray at the working place and working hours) prevailed in Chornobyl forces. According to of some authors [15] the errors of these methods were 250% and 500%, respectively.

The execution of decontamination of the Unit #3 roof in the period from 19.09 till 2.10.1986 could be the only exception. In these works, besides the calculation method, the obligatory operational control of radiation dose for participants was put into practice using dosimeter ДКП-50 А (DKP-50A) [16, 17]. In total 3,026 militaries took part in this work. I.e., taking into account that the total number of military liquidators amount to about 300 thousands, we should conclude that only about 1% of liquidators were really provided with instrumental dosimetric control, but not 14% as was mentioned by V.V.Chumak [8].

It should be noted, however, that the organization of ChNPP Unit 3 decontamination work also gave an example of failing to meet the Order-established norms: in defiance of all the then existing orders, the one time exposure dose limit of 20 rem was established for participants of ChNPP Unit 3 decontamination work by the Guidance For Work Organization And Performance [18], which was not introduced by any order. And because military man were involved, who had already been exposed to some doses, in certain cases the total dose exceeded 25 rem.

Another attempt to organise the day-to-day dosimetric control of almost all military liquidators using dosimeter ДПГ-03 (DPG-03) was made at the end of 1989 –beginning of 1990, and also failed.

The liquidator contingent with reliable doses can not be expanded by individuals from groups where doses were monitored by the «group» method, since servicemen who wore ID were constantly replaced. Therefore, total individual exposure doses for military liquidators, identified based on individual dosimeters are virtually missing.

It should also be borne in mind that the estimated “group” dose assessment would normally use the military roentgenometer-radiometer DP-5, while the “group” assessment method– the DP-50A dosimeter. Both devices were calibrated in Roentgens, accordingly, the records in the ACL military unit exposure logs were also made in Roentgens. However, when filling out Registry questionnaires, instead of Roentgens, the same value but in rem was entered automatically, without factoring in the conversion rate of 0.67–0.71, which also contributed to overestimating the official dose records (ODR).

Therefore, on the one hand, military liquidators are best provided with official dose records [8], while on the other hand – there are serious doubts about the quality of those dose values because of the predominance of the "group" and estimated "group" methods of their assessment. A major effort to verify those doses would be needed if we were to use the data on the exposure of military men in epidemiological studies [8, 15].

Veryfication of radiation doses to military liquidators

The first stage of verification addresses the objectivity issue of dosimetric monitoring. A whole series of verification methods to deal with available dosimetry information has been proposed, the predominant majority of which are based on variation statistical methods.

Due to monitoring of the doses with near-permissible values, the distribution of doses around the boundary value becomes normal. The so-called hybrid lognormal distribution (combination of logarhithmically normal and normal distribution) gives a good reflection of data observed in many of such cases [18].

The attempts to clarify the dosimetric monitoring objectivity situation in the LAC Units that we know of were made based on a statistical analysis of too generalized information [15, 19], or using insufficiently accurate database of the All-Army Registry [20] without considering the organization specifics of service, work and dosimetric monitoring in those units.

The irregular distribution of military liquidator exposure doses, being generally limited within a range of 10–25 rem, led some authors to conclude that the main source of distorted dosimetry information in Chornobyl Registrys are the relevant Services of MD units [15, 19]. These authors believe that the range of activities performed by MD units was very wide and only a portion of it was related to exposure to significant individual doses. In other words, a wide range of tasks to deal with must correspond to a wide enough and smooth distribution of individual doses.

To clarify this issue, we have analyzed the military liquidator exposure doses for various LAC activities, which differed in principle by nature of activity and health conditions. The outcome of this analysis for May 1986 - May 1987 is given in Table 4 and Figures 2–6.

Table 4.

Average radiation doses to personnel of different units

№	Name of the unit and branch	Sample size, persons	Region of operation	Work character	Average dose, cSv
1.	Detached Mechanised Regiment (DMR) of Civil Defence	4704	ChNPP	Decontami-nation	22,57±0,10
2.	Military Construction Battalion (MCB), sappers	3489	ChNPP, 10-km zone	Decontami-nation, construction	20,02±0,08
3.	Gas Defence Brigade (GDB), Chemical Forces	2465	ChNPP, 10-km and 30-km zones	Decontami-nation	20,08±0,15
4.	Rear and technical provision units	2158	30-km zone and outside it	Rear technical provision	7,82±0,91
5.	817 Operational Group (OG), management body	1164	30-km zone	Management	9,23±0,60

The Table 4 data indicate that the average military liquidator exposure doses are determined by the area and nature of LAC activities performed. Specifically, the average doses are much lower for units that did not performed work directly at the ChNPP industrial site. Maximum doses are observed in CD, chemical and engineering units; much lower ones in administrative units; and minimum ones in logistics units.

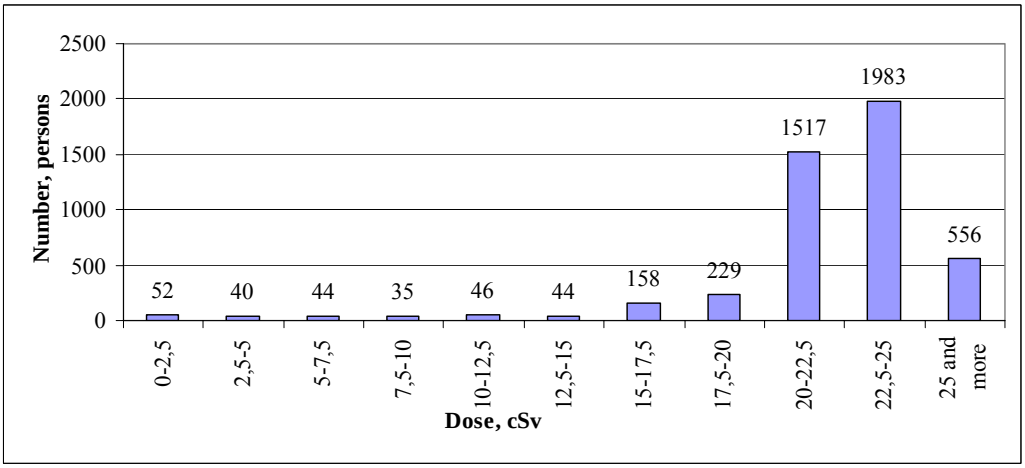

Fig. 2. Distribution of radiation doses to military personnel of detached mechanised regiment in period since May 1986 to May 1987 (n=4704).

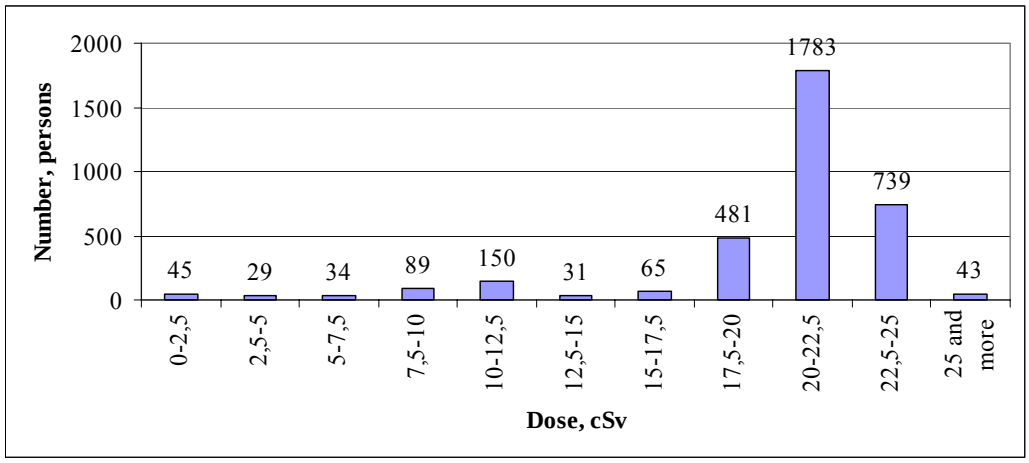

Fig. 3. Distribution of radiation doses to personnel of military building battalion in period since May 1986 to May 1987 (n=3489).

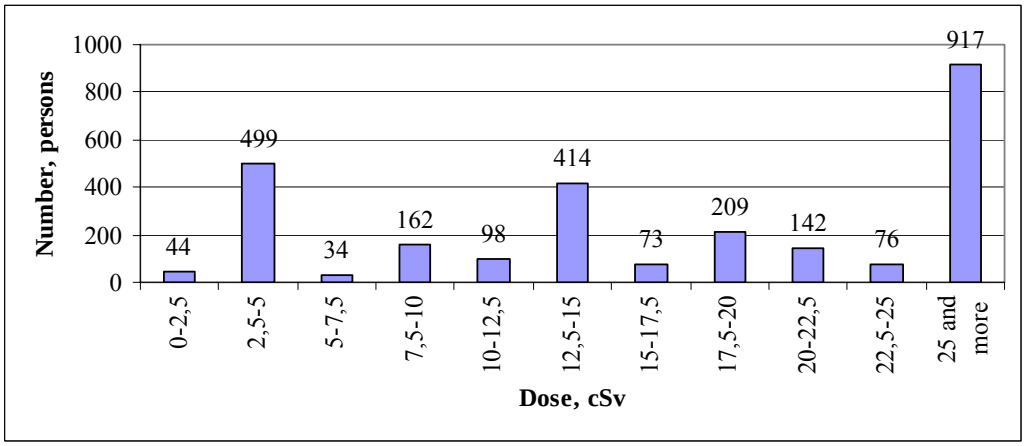

Fig. 4. Distribution of radiation doses to military personnel of 25 gas defence brigade in period since May 1986 to May 1987 (n=2465).

Accordingly, the exposure dose values for SMR and MEB, which worked under the most radiologically hazardous conditions, are skewed towards the permissible dose limit of 25 cSv (Fig. 2, 3). Because various CPB units were both onsite at ChNPP and at various distances from it, the exposure dose distribution for this part of liquidators has a somewhat different nature, but most doses still are placed around 25 cSv (Fig. 4).

In the opinion of some authors [8], that we share, such an irregular distribution of doses for CD, chemical and engineering units resulted from a stringent dose management rather than total falsification. Therefore, the major doubts held by some authors as to objectivity of dosimetric monitoring in LAC units are primarily due to these researchers' insufficient awareness of the organization of dosimetric monitoring and activities of this liquidator contingent. Yet one cannot totally dismiss facts of dose falsification, nor the possibility of unmonitored exposure of a certain part of liquidators to doses significantly exceeding the permissible ones [9].

It should be taken into account that a monetary compensation adding up to 5 monthly remuneration rates was provided for exposure to a dose of 25 cSv and above. In other words, there was a significant material "interest" in receiving a dose of 25 cSv and higher. Once the dose limit was set at 10

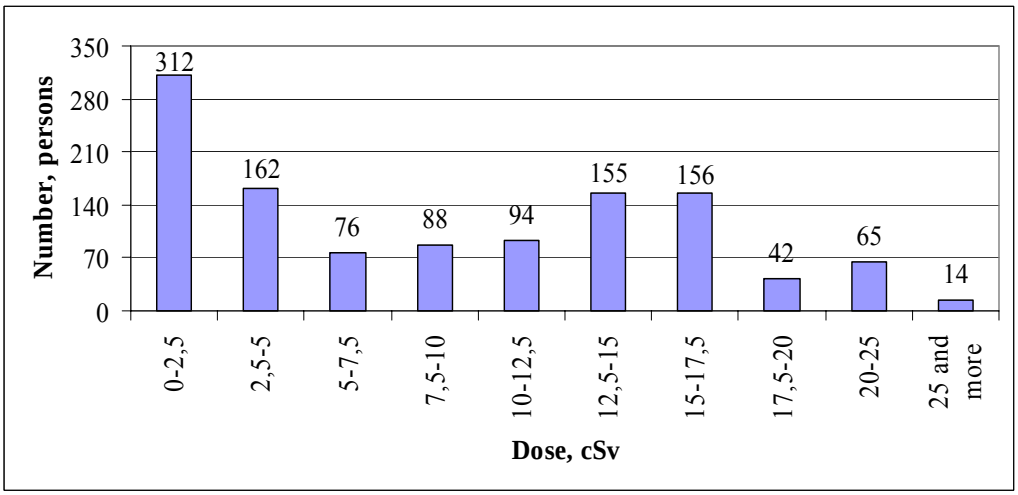

Fig.5. Distribution of radiation doses to military personnel of 817 OG in period since May 1986 to May 1987 (n=1164).

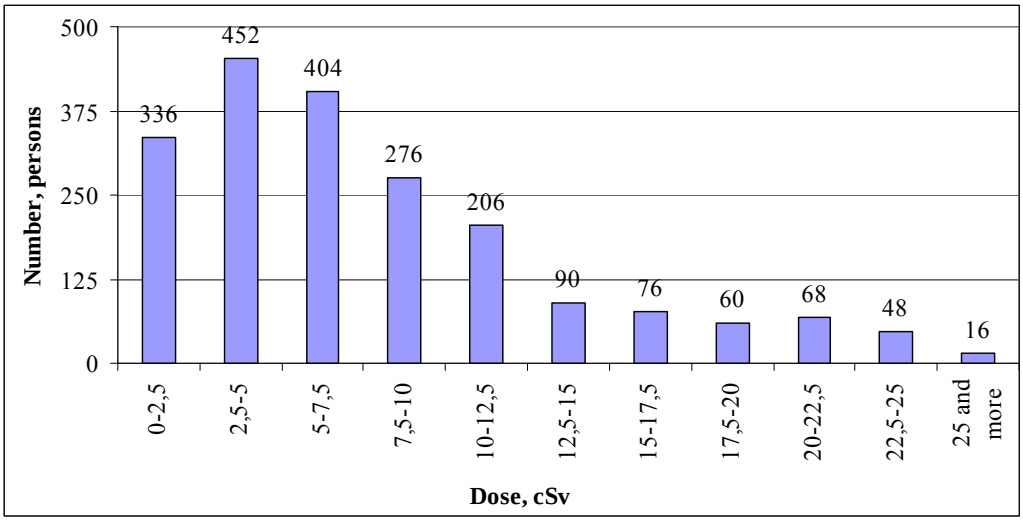

Fig. 6. Distribution of radiation doses to military personnel of rear and technical provision units in period since 22.06.1986 to 08.08.1987 (n=2158).

cSv, cases of reaching the dose limit became singular, and cases of exceeding 10 cSv went virtually unrecorded, which can support our assumption. It should be noted, however, that cases of modifying exposure doses for social reasons had place among liquidators from other ministries and agencies [8].

For OG 817 and especially for the logistic units that worked under more favorable conditions in terms of radiation exposure than the aforementioned ACL units, the exposure dose distribution is close to logarithmically normal (Fig. 5, 6).

Therefore, the exposure dose value and the nature of dose distribution in military liquidators are generally consistent with the nature of LAC activities and exposure conditions. But, in general summaries the dose distribution specifics in serviceman of LAC units, which worked under safer radiological conditions, is offset by the data on exposure doses in the more numerous CD, chemical and engineering forces.

Another step in dose verification is to establish a ratio between officially recorded (obtained via the "group" and estimated "group" methods) and specific reference military liquidator exposure doses, which objectively reflect the real situation.

As reference ones, we will use 2,447 records for military liquidator exposure doses measured with thermoluminescent dosimeters, courtesy of the archives of Kombinat Production Association (eventually transformed into RPA Prypyat).

Based on these data we have calculated the average doses received by servicemen for two weeks (basic term of wearing a dosimeter), total exposure doses were calculated for 12 weeks – a duration of military liquidator stay in the ChNPP area that is also a conservative enough assumption.

A comparison of doses calculated based on measurement and official dose records (ODR) in the same contingents is shown on Table 5. The Table 5 data indicate that ODR exceed the doses obtained through individual dosimeters, by an excess of 4.5 times in1988 and more than twice – in 1989 and 1990.

Table 5.

The ratio between calculated and measured by individual TLD doses for military liquidators

№ з/п	Year	Average dose obtained by estimation method, cSv/number of persons in group	Average dose measured by individual ers DPG-03, cSv/number of persons in group dosimet.		Ratio between estimated and measured exposure doses
			For 2 weeks	For 3 months	
1	1988	5.56 ± 0.97/7502	0.2± 0.05/68	1.2	4.63
2	1989	3.12 ± 0.12/5862	0.22±0.03/568	1.32	2.36
3	1990	4.94 ± 0.22/2748	0.36±0.03/1811	2.16	2.29

Also noteworthy is the ratio between projected (estimated) and actually measured with ID of the RMP 50A type exposure doses of the military men who decontaminated the ChNPP Unit 3 roof. Table 6 provides literature [17, 20] and archive data on the exposure doses of this contingent. Again we see that the projected (estimated) dose in average is twice that actually obtained.

When analyzing other archive materials, we found evidences of dose overstating aimed on pre-term exemption from military training [22], as well as methodic problems of different kind [23, 24]. By the way, cases in which the group method gave precise values were quite rare, and dosimeters Д-2Р (D-2R, desined for use in nuclear industry, being a kind of ionisation chamber) used in this method in the conditions of hard beta-radiation overstated the dose no less than twice.

I.e. the analysis of radiation doses of large contingents of military liquidators showed that ODR no less than twice overstated the really received radiation doses.

Table 6.

The ratio between calculated and measured by individual dosimeters doses for military liquidators participated in decontamination works on the roof of Power Unit #3.

№	Date of work	Number of liquidators, persons	Average dose by calculation method, R	Average dose by individual dosimeter meterage, R	Ratio
1	28.07.86	8	1	0.4	2.5
2	19-20.09.86	133	20	8.5	2.35
3	21.09.86	307	20	10	2.0
4	22-23.09.86	953	20	9	2.22
5	24.09.86	376	20	10.6	1.89
6	26.09.86	270	20	13	1.54
7	27.09.86	300	20	16.2	1.23
8	14.10.86	30	20	8.26	2.42
9	15.10.86	16	20	9.9	2.02
10	16.10.86	28	20	10.29	1.84
	Total	2421			2.07

Morbid and mortal events of military liquidators during performance of LAC works

The data on pre-term dismissal of military servants of SMR and CPB units for the reason of health problems are presented in Table 7. First of all, it should be mentioned that these data are not fully consistent with the realities and are insufficient for well-grounded conclusions. In particular, it is unlikely that the aforementioned units should have had more cases of dismissals for health considerations in 1987 than in 1986. Yet these data are quite enough to state that in a predominant majority of liquidators dismissed for health considerations, their exposure doses and duration of stay in the accident area were significantly less than in their colleagues who had no health concerns.

In a predominant majority of liquidators exposure doses were at the level where they had just some likelihood of physiological deviations unrelated to health dysfunctions. The opinion that radiological factors made a very insignificant contribution to deterioration of liquidators' health can be attested by the fact that two out of three liquidators deceased were recorded on the third and fifth day of their stay in the wrecked ChNPP area, and the duration of stay of the third deceased was also within average for their unit. The main cause of death in all these cases was acute cardiovascular deficiency.

In some orders issued by military unit commanders we find records on other lethal cases among liquidators, but no summary information available on this issue. Therefore, we can provide but very rough estimates of total lethality by extrapolating the ratio of the number of SMR serviceman and number of deaths among them onto the total number of liquidators. Since the total number of persons who served in SMR in January – June 1987 was about 2–3 thousands, then the total death-toll for the contingent of 300 thousands could have been about 300–450 cases.

The Chornobyl Military Force Commander Order № 5 dated 29 January 1990 [26] indicates that in a majority of military units no in-depth medical examinations are conducted, resulting in cases of late diagnostics of ailments, up to lethal ones (private K. – shower & laundry detachment, praporshchik D. – military trade unit 960, private S. – military detachment 63279 etc.). And that happened in 1990, when the military liquidator exposure dose did not exceed 5 rem.

Table 7

Dismissals, exposure doses and duration of stay in the accident area for servicemen of SMR and CPB during 1.05.1986 through 31.12.1987

Year	Work period	Exposure dose, cSv		Average duration of periods of staying in Chornobyl zone		Number of liquidators dismissed for health considerations	
		DMR	GDB	DMR	GDB	DMR	GDB
1986	April- May	23.23±0.2	18.4±0.4	28.9±0.6	21.6±0.8	- ???	1*(7)/(25)
	June-August	22.17±0.4	14.3±0.6	55.7±0.5	29.3±0.4	1	1*(36)/(2.5) 1*(28)/(14)
	September-December	23.1±0.2	24.3±0.3	57.3±0.3	41.7±2.2	1	-
1987	January-June	22.1±0.19	18.1±0.5	69.6±0.7	69.1±1.9	**1**(53)** **1**(3)** **1**(5)** 1*(53)	-
	July-December	10.7±0.28	9.3±0.2	72.1±1.2.	54.1±1.5	1*(20) 1*(21)	1*(39)/(4.8) 1*(51)/(7.02) 1*(30)/(0.2) 1*(49)/(6.0) 1*(47)/(4.3) 1*(39)/(8.8) 1*(71)/(3.7) 1*(35)/(5.5) 1*(44)/(9.1) 1*(35)/(5.7) 1*(69)/(8.9)
Total during 1986 and 1987						10	14

* in parenthesis duration of period of staying, days (numerator) and radiation dose, cSv (denominator);
** liquidators died in Chornobyl zone, in parenthesis duration of period of staying in the zone.

Researchers of the morbidity problem detected no essential connection between availability of liquidator complaints and duration of their stay in the accident area, as well as the location and nature of recovery activities [27]. The Table 8 data can also confirm that it was other factors rather than the radiological one that was the cause of liquidator health condition deterioration.

Table 8.

Dismissals and exposure doses for military liquidators of the first and third sectors during 20.12.1986 through 30.03.1987

№	Subordination	Period	Number of dismissed for health considerations	Average dose for dismissals for health considerations, cSv	Average dose for liquidators in 1986–1987, cSv
1	Sector 1 (Blorussian Command)	20.12.86-16.03.87	84	2.39±0.13	5.7±0.3
2	Sector 3 (Prycarpathian Command)	03.01.87-30.03.87	23	9.57±1.29	15.17±2.3

The exposure doses for military liquidators of the first and third sectors who were dismissed for health considerations did not exceed the average for the whole sectors and those levels that could theoretically cause changes in their health condition.

In our opinion, the sudden conscription with a drastic change of habitual living and working conditions, frequent relocations in the accident area provoked a major strain of adaptive mechanisms and transition of certain body parts and systems, primarily the cardiovascular one, to a critical functioning mode. It was what induced the aggravation of chronic diseases and sometimes – emergence of critical conditions and lethal cases. The radiation factor is seen from the exposure doses available to have been one of the least significant one.

As a results of a large number of liquidators dismissed for health considerations, people developed a belief that recovery work at ChNPP was extremely dangerous, hence the liquidator contingent grew, which intensified the psycho-social consequences of the accident.

Conclusions

1. The State's unpreparedness for action in emergencies; charging the Armed Forces with unfeasible tasks; predominance of manual labour in LAC; use of DM methods that overestimated dose by about twice; imperfect system of medical selection of reservists drafted for a training assembly for LAC, –that altogether unreasonably enlarged the liquidator contingent, increased LAC costs and intensified the socio-psychological consequences of the Chernobyl Disaster.

2. The system of radiation safety and security of the Chernobyl Military Force, whatever its shortcomings may have been, has prevented military servicemen from being massively exposed to doses capable of inflicting radiation injuries.

3. The exposure doses and duration of stay in the accident area of military liquidators who were dismissed for health considerations or died during their stay in the accident area were notably lower and shorter than average for the unit where they served.

4. Scientific attention should be paid also to the influence of non-radiation factors (such as stress etc.) on the health state of military liquidators during their recovery works and in long-term aspects.

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