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Timber Committee  
European Forestry Commission

Joint Committee on Forest Technology, Management and Training

## **SEMINAR ON CLOTHING AND SAFETY EQUIPMENT IN FORESTRY**

**Kuopio (Finland), 27 June - 1 July 1994**

### **REPORT OF THE SEMINAR**

(as approved by the seminar)

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## **INTRODUCTION**

1. The Seminar on the "Use of clothing and safety equipment in forestry" was held in Kuopio at the invitation of the Government of Finland from 27 June to 1 July 1994. It was organized under the auspices of the Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training. Participants attended from the following countries: Austria, Canada, Chile, Croatia, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Netherlands, New Zealand, Norway, Russian Federation, Switzerland, Tanzania and Ukraine.

2. On behalf of the Ministry of Labour, the seminar was opened by Mr. E. Yrjänheikki, chairman of the organizing committee, who underlined the two main purposes of the seminar: to share the findings of scientific research with practitioners and to exchange information within an international forum. Emphasizing the need for seminars of this kind, Mr. M. Salmenperä, Head of Division in the Ministry of Labour, reminded the seminar of the fact that still most forest workers in industrialized countries did not reach normal pension age and that there were even greater deficits in labour protection in many developing countries. Mr. J. Heino from the Ministry of Agriculture and Forestry stressed, that by addressing problems of the forestry workforce, the seminar promoted important aspects of sustainable forest development. He expressed his high appreciation for the work of the Joint Committee and the FAO/ECE Timber Section in Geneva. For the scientific committee, Mr. J. Kangas, Director of the Kuopio Regional Institute of Occupational Health, expressed his gratitude to the various sponsors and collaborators, who had made the seminar possible.

### **ADOPTION OF THE AGENDA** (Item 1 of the agenda)

3. The provisional agenda as set out in TIM/EFC/WP.1/SEM.39/1 was adopted.

### **ELECTION OF OFFICERS** (Item 2 of the agenda)

4. Mr. H. Jokiluoma (Finland) was elected Chairman. The following discussion leaders were appointed:

Item 4 Mr. H. Schipper (Netherlands)

Item 5 Mr. K. Ojanen (Finland)

Item 6 Mr. C. Pollini (Italy) and Ms. K.A. Sand (Norway)

Mr. H. Tapola (Finland) was requested to act as rapporteur for the poster session.

### **GENERAL INTRODUCTION TO THE SEMINAR** (Item 3 of the agenda)

5. Mr. P. Poschen, ILO, gave an introduction to the seminar. Asked what role attitudes played in the promotion of work safety, he observed that attitudes were the key to safer and healthier forest operations. Attitudes did, however, matter at all levels not only among forest workers. Where attitudes towards safety were negative, it was important to establish the reasons for this. He suggested that ignorance and lack of information were not usually to blame. In many cases very real economic constraints and incentives were at the root of the problem.

**REQUIREMENTS FOR WORKING CLOTHES AND PERSONAL PROTECTIVE EQUIPMENT (PPE)** (Item 4 of the agenda)

6. The following speakers presented papers under this item: Mr. J. Arteau (Canada) on requirements for working clothes and PPE; Mr. Z. Kárpáti (Hungary) on new regulations for PPE in Hungary; Ms. T. Risikko (Finland) on deficiencies of protective clothing; Ms. K.S. Sand (Norway) on accident prevention and consumer awareness; Mr. J. Stasa (Latvia) on problems in occupational safety; Mr. V. Louhevaara (Finland) on the workload of wearing boots in snow; Mr. H. Anttonen (Finland) on problems caused by cold in forest work; Mr. H. Jokiluoma (Finland) on labour inspection in forestry; Mr. E. Korhonen (Finland) on regulations and standards for PPE in the European Union; and Mr. J. Lorbach (Germany) on the German testing system for clothing and PPE.

7. The discussion of the presentations by Messrs. Kárpáti and Stasa suggested that the high cost of protective equipment was the biggest obstacle to its widespread use in countries in transition where forest operations had been privatized. Small contractors and land owners could not afford to buy equipment costing about one month earnings of a forest worker.

8. In the discussion of his presentation on European standards for PPE, Mr. Korhonen confirmed that the European Commission had not classed chainsaw use into hazard category I, i.e. potentially fatal hazards. As a result, the less stringent requirements of category II applied to chainsaw PPE. These call for mandatory type testing of PPE, but do not impose quality control for manufacturing. Finland had failed to obtain a reclassification into category I. Several speakers agreed that the present classification was an error that should be corrected.

9. Commenting on Mr. Lorbach's observation that available clothing and PPE design still left a lot to be desired, several speakers suggested that financial constraints and cost were important factors. In Germany, budgetary restrictions of public forest employers slowed down the pace of introduction of new designs. According to Mr. Arteau, there were several promising fibres and materials that could not be brought beyond preliminary laboratory tests, because the recession in the forest industry had also drastically reduced the market for PPE. Mr. K. Ojanen (Finland) regretted that field testing of clothing and PPE is only carried by manufacturers in the Nordic countries. He felt that independent, third party testing would be desirable.

**WORKING CLOTHES AND SAFETY EQUIPMENT FOR THE FUTURE** (Item 5 of the agenda)

10. Presentations under this item of the agenda were made by the following speakers: Mr. R. Parker (New Zealand) on the reduction of injuries through PPE; Mr. E. Toppila (Finland) on the efficiency of hearing protection; Mr. O. Raemy (Switzerland) on safety promotion; Ms. H. Mäkinen (Finland) on the design process for protective clothing; and Ms. H. Meinander, presenting a paper by Ms. H. Laamanen and herself on studies on thermal comfort using a sweating thermal manikin.

11. Mr. Parker expanded on unresolved problems with helmets in New Zealand such as ventilation and strength. He explained that helmets were effective but could

not prevent all injuries. Helmets, strong enough to resist all impacts, would be far too heavy. Concerning improved ventilation, Mr. Korhonen informed about Finnish experiments with aeration holes in helmets. These showed that sufficient space between shell and head was very important for effective ventilation through the holes.

12. Mr. Parker added that there was also a problem with boots in New Zealand as rubber boots, which alone can meet the European standard, are uncomfortable in the warm climate.

13. Mr. E. Toppila (Finland) confirmed that the light earmuffs presently used provided insufficient protection. Heavier eardefenders would be more effective but too uncomfortable to wear and also more expensive.

14. Ms. H. Mäkinen (Finland) estimated that the development of new models and designs for clothing and PPE, including field tests, would normally take two to three years. Asked for the fibre of her choice for work clothing, she named cotton, polyamid and polypropylen. She added that new synthetic fibres were very interesting, but that it was too early to judge.

#### **SAFETY IN PRACTICE** (Item 6 of the agenda)

15. The following speakers presented papers under this item of the agenda: Mr. T. Klen (Finland) on safety equipment and working behaviour; Mr. J. Starck (Finland) on chainsaw-induced vibration symptoms; Mr. C. Ackerknecht (Chile) on forestry development and working conditions; Mr. K. Ojanen (Finland) on PPE in Northern logging areas; Mr. J. Wang (China) on logging accidents; Mr. E. Kastenholz (Germany) on human behaviour and accidents; Mr. H. Anttonen (Finland) on machine maintenance in cold zones; and Mr. C. Pollini (Italy) on safety and work organization.

16. Mr. Klen had focused on the psychological aspects of the adoption of PPE and presented evidence that the use of PPE has a significant effect on the risk assessment and risk taking among the users. Risk reduction through PPE was often partly compensated through a more risk taking behaviour. Some training schemes in the Nordic countries, like the "teho" (= efficiency) programme were promising for avoiding this compensation.

17. Asked if any attempts been made to compare the behaviour of users and non-users directly, he referred to the ethical limitations and the complications of performing such a study without influencing the subjects. He confirmed that the severity of the injuries was taken into account in his studies. The impact of pay systems could not be studied because these were determined by collective agreements.

18. In response to a question about the connection between smoking and white finger disease, Mr. Starck commented that a correlation was likely because smoking reduced peripheral blood circulation and thus increase the risk. There were, however, no studies on this subject.

19. Mr. Ackerknecht confirmed that the programmes of the Chilean Safety Association to introduce certification and better training in forestry targeted

both larger and smaller companies. Because of the scarce resources they have in hand and the magnitude of the task they are facing, it was necessary to channel the programmes through the more established big companies. The latter acted as multipliers for examples by including safety requirements in their contracts with small logging firms.

20. In a comment on Mr. Ojanen's survey on the use of PPE in Scandinavia and Alaska, Mr. Arteau emphasized that the findings were representative for part of the United States. The situation of Canadian forest workers in respect of PPE was very similar to that in Northern Europe.

21. Mr. O. Dammerud (Norway) questioned the usefulness of the standard for protective gloves which was presently under preparation. He maintained that most protective gloves reduced the grip of the saw and thus were rather counterproductive. Mr. Korhonen responded that most countries did no longer consider protective gloves with a padding on the back of the left hand necessary. Chainbrakes by and large eliminated the risk of cuts to this part of the body.

22. Mr. Kastenholtz was asked what evidence was available to show that workers were often wrongly held responsible for accidents, when actually conditions outside their control were to blame. He responded that at the moment the only evidence were questionnaire surveys of workers' opinions and individual cases and examples. Research should start to actively look for accident causes beyond apparent human failure. Available statistics were all but useless for such research, but case studies and accident analysis using techniques like the "tree of causes" could prove valuable. It was important to change the focus from trying to find who was responsible to understanding why it happened and how it could have been prevented. Mr. Arteau agreed with the speaker's point that work organization was of utmost importance for work safety. He drew attention to studies in Quebec published by E. Cloutier and others which highlighted these interrelationships. References to these studies are listed in the bibliographies on pp. 30 and 61 of the abstracts book.

#### **GROUP WORK** (Item 7 of the agenda)

23. Following the paper presentations in plenary sessions, seminar participants met in working groups for more in-depth discussion of relevant topics. The following groups were established:

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|---------|--|
| Group 1 | Working clothes and PPE in the countries in transition;                              |
| Group 2 | Needs to develop working clothes for cold climates;                                  |
| Group 3 | Needs to develop working clothes and PPE for hot climates;                           |
| Group 4 | Needs to develop PPE for cold climates;  |
| Group 5 | Ways to increase the use of PPE from the technical and organizational point of view; |
| Group 6 | Ways to increase the use of PPE through changes in attitudes.                        |

Group findings were presented and discussed in plenary sessions. Summaries are contained in Annex II of this report.

24. The seminar programme also included a poster session: 21 posters, exhibits and videos were presented. A summary is given in Annex III to this report.

## **CONCLUSIONS AND RECOMMENDATIONS** (Item 7 of the agenda)

### **A. Conclusions**

25. There has been significant progress in the design and use of working clothes and personal protective equipment (PPE) over the last 20 years. Purpose-built clothing and PPE have become an integral part of strategies to prevent accidents and to preserve worker health in many ECE countries. Modern PPE can substantially reduce injury frequency and severity and prevent health complaints such as hearing damage. International and national standards, as well as labels such as the European "CE" and the German FPA labels guarantee quality products based on independent, third party testing.

26. The potential of PPE is, however, far from being fully utilized. PPE is hardly used in some countries and by some groups of forest workers and not as effective as could be expected where it is used. The reasons for this are manifold and include a neglect of other factors influencing work safety, negative or counter-productive attitudes towards safety and PPE, persistent deficits in design, and cost.

27. PPE is not effective as an isolated measure nor does it prevent accidents. It merely leads to fewer and less severe injuries. Adequate technical training of forest workers covering also safety and health precautions is indispensable, if tolerable accident levels are to be achieved. Skill testing leading to certification is a promising way of ensuring that all workers have the skills required for their job. It is equally important that safety is built into all aspects of work organization from work planning to remuneration and working conditions.

28. The possibilities to improve safety through better work organization have only been explored to a limited extent. There are, however, clear indications that many accidents attributed to wrong behaviour of the worker in present accident statistics do actually originate in factors outside the worker's control. The real causes of accidents are still very poorly understood. Conventional accident statistics, if available, are of little help as they are too superficial. They only record the apparent cause of an accident rather than the underlying chain of events. Present accident statistics also do not usually differentiate between work operations, which limits their value for the design of preventive measures, including PPE. Accident analysis and investigations at the work place by safety committees, health personnel, accident insurances and labour inspectors are therefore very important.

29. Another factor that greatly influences the use and effectiveness of PPE are attitudes at all levels from worker to manager. In some countries, a "loggers are tough guys" attitude is one of the factors limiting the use of PPE. Perhaps more importantly, PPE users appear to change their attitude by working in a different way and taking higher risks than they would without protection.

This compensation eliminates a significant share of the protection PPE could otherwise provide.

30. PPE is used to a very limited extent in hot climates, in the countries in transition and among some groups of forest workers, in particular farmers, self-employed and small contractors. A lack of information explains only part of this reluctance. Much of it has to be attributed to persistent design problems, such as high weight, the impediment of movement, poor evacuation of heat and accumulation of moisture, causing serious discomfort. These problems concern mostly protective trousers and boots, but in hot climates also helmets. At present there is hardly any clothing and PPE available adapted to forestry work in hot climates. In a more moderate form the same problem is encountered in temperate climates in the summer. There is also a need to adapt good base design to local conditions such as terrain and work methods.

31. Cost is a major deterrent for occasional users and self-employed and small contractors with relatively low earnings. This situation is a grave concern because it means that the groups most in need of PPE are the ones using it least. In many countries in transition, PPE is not affordable as its current cost often is the equivalent of a full month earnings. There is little information or awareness of cost savings through the use of PPE. Incentives often work in the wrong direction as the cost of accidents is shared by a wider group through insurances, while PPE has to be paid by the individual worker or employer.

32. Managers, but also accident insurers, trainers, labour inspectors, researchers and manufacturers, have an important role to play to resolve the above problems. Managers need to change their attitude and actively promote work safety. They can and have to positively influence attitudes among their workers. All parties can contribute to putting available information to use in order to produce working gear that is lighter, better adapted to temperatures and local conditions, more effective and also cheaper and to stimulating innovation in this direction.

#### **B. Recommendations to the Joint Committee**

33. The Joint Committee should continue to emphasize occupational safety, training and other human resources related aspects of forestry in its programme of work. Care for the forestry workforce is an important part of sustainable development of forestry as a whole. Specifically, the Committee should consider organizing activities on the following topics: developing work organization to make forestry a life-long occupation; occupational safety and health problems in highly mechanized operations; and psychological and social causes of accidents. The seminar "Safety in forestry is feasible" which is to be held in Switzerland in October 1996 should also consider the integration of safety and PPE in quality control and efficiency improvement programmes at company level as promising ways to enhance work safety. Furthermore, the Joint Committee should identify ways of exchanging information on certification schemes and on work psychology. The ILO "Forestry workforce network" should be used for this purpose.

34. With regard to working clothes and PPE, the Committee should organize a follow-up seminar in a few years time. This seminar should be organized in co-operation with IUFRO and involve company executives to raise awareness among

managers. It should also discuss possibilities to use working clothes for image building of forest workers, thereby creating a positive attitude towards PPE. In addition, it would be useful to publish a state-of-the-art report on working clothes and PPE as well as a list of resource persons and institutions in this field, such as LIRO, KWF, the Finnish Institute of Occupational Health with its regional units and IRSST.

35. The Committee should endeavour to spread information on PPE to the Eastern and Central European countries in transition and to organize training for nationals from these countries through multi-or bilateral channels. These efforts should also be targeted at the Ministries of Labour and of Health in the respective countries.

### **C. Recommendations to member countries**

36. PPE should be made available to all groups of forest workers and the use of necessary PPE should be mandatory. PPE users should be assisted with the selection, use and maintenance of PPE. This could for example be done by fuller information on properties and range of use by manufacturers, through the training of retailers as advisors and through a ranking of PPE by a council representing a cross-section of stake-holders in the forest industry.

37. All countries should adopt norms based on international standards and principles for PPE design and use as part of occupational safety and health regulations. The countries of Eastern Europe should be enabled to participate in international standard setting. The needs for assistance in the area of PPE in the countries in transition should be assessed, to provide assistance in the promotion design and manufacture of suitable and affordable protective gear. Common standards should also be adopted for the testing of PPE and testing and certification services made available to countries which lack the necessary facilities.

38. The forestry sector and equipment manufacturers should cooperate closely to stimulate innovation and to translate research results into better and more comfortable products adopted to local conditions. Particular efforts should be made to develop PPE for use in warm climates.

39. Managers in the forest industry should play a more active role with respect to work safety. As one of the measures to enhance work safety, they should promote the use of PPE and a positive attitude among their workers. Work safety and the use of PPE should become part of quality control and efficiency improvement systems and recognized as a means of making operations more productive and profitable. To this end, an explicit safety policy should be formulated and safety targets should be set, backed by adequate resources for implementation. Close and regular labour management cooperation at the work place should be used as one of the means to achieve the targets.

40. Member countries should attach high priority to improving work safety and to promoting the use of PPE among groups that are exposed to high risk, but do presently use PPE only to a very limited extent, such as self-employed, small contractors and farmers. Training courses should include information on PPE and tax deductibility of PPE should be considered. Skill certification for



contractors and forest workers is a promising way to improve work safety and should include the use of PPE as a criterion in tests and accreditation.

**D. Recommendations to research institutions and IUFRO**

41. Research organizations should attach high priority to filling the major gaps in our understanding of the causes of accidents, of ways to prevent them and of the best use of PPE to this end. Specifically, research should be undertaken on the interrelationships between management structures, work organization and safety. This should include the effect of different pay systems on accidents and health; studies on the safety performance of self-regulated work teams; and the impact of PPE and clothing on worker performance.

42. Exposure recommendations should be established to match clothing and seasonal weather variation, as well as risk and exposure limits for work in particularly cold and hot climates. These recommendations should be based on reliable data about the impact of extreme temperature, of maintenance and of other factors on the strength, reliability and useful life time of clothing and PPE.

43. Safety at work and PPE should be considered at IUFRO's World Congress in Tampere (Finland) in 1995.

**OTHER BUSINESS (Item 8 of the agenda)**

44. Study visits were made as two half-day excursions to a forest area in Eastern Finland on Tuesday 28 June and to the laboratories of the Institute of Occupational Health in Kuopio on Thursday 30 June. Reports on the visits are given in Annex I.

45. On behalf of the participants and of the Joint Committee's Steering Committee, Mr. H. Schipper expressed the profound gratitude to the Government of Finland and to all organizers of the seminar and study visits, for the outstanding arrangements made, the highly interesting visits and the generous hospitality. The large number of countries represented, the quality of the presentations and the liveliness of the discussions made this seminar a fine example of how useful international exchange was and underlined the valuable contribution the Joint Committee was making to this exchange.

**ADOPTION OF THE REPORT (Item 9 of the agenda)**

46. The draft report that had been prepared by the secretariat was adopted with some modifications, which have been incorporated in the present document.

## **ANNEX I**

### **Excursion: "Forest Work in Eastern Finland", Finnish Forest and Park Service (Tuesday, 28 June 1994)**

The excursion led to the Kaavi forest some 80 km east of Kuopio, which belongs to the Finnish Forest and Park Service (FPS). Since 1 January 1994 FPS is a state enterprise, working under the Ministry of Agriculture and Forestry. The enterprise is divided into five divisions/business units namely, Forestry, Nature Protection, Seed and Plant Production and Natural Resources Development. The Forest unit is the largest and also the most important financial contributor. FPS administers 3.2 million hectares of forest land, 3.9 million of statutory protected areas and 1.4 million of less productive forests and waste land.

One of the objectives of FPS is to provide employment in rural areas. While most of the logging operations are mechanized and carried out by contractors, the share of employed forest labour is still considerably higher (about 2.000 employees in the forestry unit) than the average among other forestry enterprises. The additional cost for maintaining a high degree of manual labour is taken into account in the budget.

At the demonstration area two logging sites were visited, one demonstrating manual and the other mechanized operations in thinnings.

#### **Mechanized logging**

The presentation started with a Valmet 901 single-grip harvester, operating in a stand of 75 year old spruce (third thinning). The 6-wheel machine weighs 13 tons and costs about 2 M Finnmarks. The harvester was owned by a contractor and operated by one of his employees. With only one operator the machine worked 10-12 hours/day. The operator himself selects the trees to be removed. Output in this stand was 12-15 m<sup>3</sup>/h.

An overview of the last two decades development of mechanization in logging operations was presented. The big leap in mechanization during the 80s had primarily been the result of the introduction of the single-grip harvesters which made it possible to introduce mechanized systems even in early thinnings. In addition, the demands from buyers for better control of the timber production further favoured the use of mechanized systems. Further development towards even higher rates (90-95%) of mechanization in logging are expected during the 90s.

One positive effect by the mechanization is that some of the harder and more dangerous tasks have been eliminated or at least reduced. On the other hand mechanization contributes to the already high level of unemployment in the forest sector. Still the forestry sector has managed to keep the number of employees on more or less the same level as in the beginning of the 80s, - this through major changes in the division of labour over the last years. Forest workers are today used to a larger extent for planning, measuring, recreation forestry and conservation, in addition to traditional production tasks.

### Manual logging

We were shown a chainsaw operating in thinning performed by a logging instructor from FPS. Even among manual workers the delegation of responsibility and broader distribution of tasks calls for a well educated and trained staff. The workers have the opportunity or/and are expected to take a more active part in the planning as well in the follow-up on their own work. The worker does for example measure his output himself, using an electronic tree calliper. Even the manual work has experienced an annual increase in productivity of 3-4% the last 10 year period.

Development of safe working methods is seen as the most important measure to prevent accidents and injuries. Personal protective equipment is purchased by the employee, but 70% of the cost is covered by the employer. The terms for these agreements are negotiated with the labour unions.

The wage level has in many ways been restored and a normal wage for a worker is around 500Mk/day, based on piece rate and 6.5 h/days. There are options for other wage systems, such as time based wages with bonus, but piece rates are more common in use. In the future manual operations are likely to be contracted out more and more.

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### **Excursion: "Kuopio Regional Institute of Occupational Health Laboratories"**

(Thursday, 30 June 1994)

After an introduction by Professor J. Kangas, the Director of the Institute, four research and testing laboratories were seen: testing of chainsaw trousers, microbiology, accoustics and ergonomics.

The excellent facilities in Kuopio are shared between the various institutions. Out of the total staff of 200, 100 belong to the National Institute and 54 to the Regional Institute of Occupational Health. The Regional Institute is one of six in the country. Its staff comprises a wide range of skills, including engineers, chemists and physicists but medical professions dominate with more than half of the staff. It disposes of an annual budget of 15 mil. FIM to carry out its mandate for studies on the health status of 300.000 workers in the area, national research projects, training, information and promotion and drafting of new regulations.

#### **Stop 1: Testing rig for chainsaw trousers**

The new European test method and test R16 was demonstrated. It complies with the LE standard EN 381-1. Safety clothing and footwear is tested according to the standards EN 381-2 to EN 381-9.

The method is based on measuring the maximum speed (rotational energy) at which the clothing or footwear is not cut through. Very careful calibration is crucial for valid results. Differences in chainsaw sharpening for example can

lead to widely varying test results. In Europe the following laboratories can test protective clothing against chainsaw cutting:

- Finnish Institute of Occupational Health, Finland;
- Statens Mäskinprovningas, Sweden;
- Satra, United Kingdom;
- KWF, Germany.

### **Stop 2: Laboratory of environmental microbiology**

The laboratory is equipped for the study of fungal spores and bacteria. The most common problems caused by microbes are: irritation of respiratory system; asthma; chronic bronchitis; allergic alveolitis; and organic toxic dust syndrom. The main research methods used are: air sampling (Andersen-impactor, filter samplers); material sampling (moldy materials, water samples); and serum samples from exposed workers for antibody tests. Research and checks forms on working environments, where microbial problems are common such as: central heating plants (wood chip handling); agriculture; food industry; waste water treatment plants; refuse disposal; sawmills; chemical wood industry (wood chip handling); and moldy buildings

### **Stop 3: Acoustic laboratory**

The laboratory is isolated from vibrations from the ground with rubber isolators that can be changed if necessary. The laboratory also contains an engine stand that is isolated from the frame with cushions. The walls and the ceiling are covered with mineral wool wedges. The inlet and outlet air channels contain effective silencers. The basic level of the background noise in the laboratory is less than 0 dB. The room can be modified from semi-anechoic to fully anechoic area by setting the mineral wool wedges onto the floor as well.

The acoustic laboratory is indispensable for numerous equipment manufacturers, as the EEC engine directive requires that the sound power level produced by a machine must be indicated, if the equivalent continuous A-weighted sound pressure level exceeds 85 dB(A) on a working position.

The sound power levels of equipments and engines are tested in the laboratory according to the international standards ISO 3745-1977, ISO 374-1981 and ISO/DIS 9641-1. The laboratory is accredited to receive an official approval for sound power level measurements by the fall this year.

Noise prevention is a big problem in development work. Effects of preventive operations for noise can be stimulated and optimal solutions for noise prevention can be found in the acoustic laboratory. The system also minimizes difficult and time-consuming noise prevention experiments.

**Stop 4: Laboratory of Ergonomics**

The laboratory is equipped for all conventional test on workload, work capacity and working postures. A very recent facility was demonstrated that allows a parallel analysis on graphs and video tape of muscle activity, heart rate, temperature and other analogous parameters. A newly developed software combines integrated EMG, data lockers and an image analyzing system. The data lockers can handle up to 16 different variables through separate channels. The video films are marked with a 0.01 sec time code on the sound track for precise image integration and retrieval. The method is very useful when optimizing physically heavy work, as well as for worker training.

## Annex II

### Summary of group work session

#### Group 1: Working clothes and PPE in the countries in transition

In the countries in transition the old standards for PPE from the Soviet Union are not seen as sufficient and consequently no longer in use, but the progress towards new rules and regulations is impeded by lack of money. Insufficient resources for research and training combined with the high costs of the PPE itself severely hold back the use of PPE in forestry. Only about 20% of the forest workers are using similar PPE as in the northern countries. However, the present level of refined and costly PPE in the northern countries may not be considered as a first step. This does not restrict the important roles of more developed countries to contribute with their knowledge in this field, e.g. on international standard setting, research and training. For the future the group suggests exchange programmes for students, institutes and universities. The group also emphasised the importance of seminars like this one in Kuopio to exchange information and research findings.

#### Group 2: Needs to develop working clothes for cold climates

The group drew up a list of possible methods for analysing working situations and hazards in forestry work. It stressed the need to obtain the workers' opinions and comments in the assessment. The methods suggested are as follows:

- job analysis to measure e.g. physical load and rest periods;
- ergonomics to measure e.g. postures and movement;
- occupational risk analysis of accidents, diseases, sources of strain, overexposure (climatic, chemical, biological and radiation) and moisture;
- classification of risks and PPE.

There are at present a number of special items of PPE for forestry work in cold climates. Further improvement is desirable as regards helmet lining, neck protector, insulative intermediate layer, extra outerwear for rest periods, insulative socks, felt lined boots, insulative gloves and mittens. The group also saw a need for further development of climatic shelters, camping cars and drying cabins at large work sites.

In order to stimulate the use of PPE the group referred to the Finnish model where the employer pays a certain percentage of the costs for PPE.

The group suggested that measures on work in cold climates be monitored through a special occupational health care system. To improve dissemination of relevant information to employers and workers the authorities concerned should follow in collaboration with existing occupational safety and health organisations and employers' and workers' organisations.

For work clothing and PPE in cold climates consideration of the following aspects is important:

- Body cooling:
  - thermal insulation (ICL)
  - duration limiting exposure (DLE)
  - insulation required (IREQ)
  - wind-chill index (WCI)
- Local cooling:
  - air permeability (Lg)
  - local insulation
- Functional properties:
  - effect on performance and energy cost (weight, stiffness, etc.)
- Frostbite prevention:
  - gloves, shoes, mask
- Manual dexterity:
  - gloves, shoes

EN-standardisation and selection of test methods is under progress. The group suggested that, as in industrial hygiene recommendations, tolerance limits for exposure to low temperatures could be divided into ceiling values, action values and threshold values. Third party field testing of PPE and clothing should be elaborated to evaluate new and existing work clothing and PPE and their suitability under extreme conditions e.g. moisture, wind and coldness.

Among the needs for research and further development the group emphasised:

- better regulation of insulation
- protectiveness against ambient moisture
- length and spacing of rest periods
- exposure criteria for low temperatures
- user training/information with follow up

### Group 3: Needs to develop working clothes and PPE for hot climates

PPE available today are mostly unsuitable for hot climates. Good protection often leads to heavier equipment and consequently heat problems. Therefore in hot climates discomfort from PPE severely reduces the working capacity. Hence it is important to develop more suitable PPE for hot climates as well as for warm seasons in the more temperate countries.

The group presented a work plan for developing the right selection of PPE in hot climates emphasising the important role of the workers' feedback in the assessment. Properties as protectiveness, comfort and durability should be regarded in the selection of work clothing and PPE. Hazards such as UV radiation, biological factors (snakes, mosquitoes) and mechanical factors (falling branches etc.) should also be considered.

The group suggested further development of light weighted, breathable, heat absorbing and skin comfortable PPE. Besides PPE other factors such as fluid intake, work/rest hours, physiological limits, calorific intake (energy) and the motivation to use PPE were considered important to reduce injury in hot climates. While keeping workers fit for work.

The group suggested that further research should focus on new materials; new designs; new technology; research on accident prevention and training. The group concluded that at present PPE could only provide limited protection in hot climates. There is a great need for developing more suitable PPE. This should also involve better training and organisational measures to promote motivation for using PPE. Up until now, because of a low demand from the market it has been difficult for companies based in tropical countries to develop new equipment themselves. For the near future at least, they will to a large extent depend on innovations from the temperate countries.

**Group 4: Needs to develop PPE for cold climates**

Field testing methods should be improved to provide better knowledge on how PPE functions and acts in extreme conditions with exposure of UV radiation, very low temperatures and the effect of ice and dirt. UV radiation has proved to have a crucial effect on helmets protecting capability. To ensure the user-friendliness in cold climates it is important that the PPE is given a design that offers thermal comfort as well as adaptation to anthropometric dimensions.

Like many other PPE the helmet originates from other sectors than forestry and is therefore not especially designed for the more complex purposes of forestry work. Hence further research to ensure its fitness and reliability is required. To improve user-friendliness several solutions on integrated faceshield-helmets have been studied in Canada (presented in the abstract book on pp. 58, Mr J. Arteau. Helmet ventilation problems could be overcome with drill holes and by enlarging the space inside the helmet, though this might affect the helmets balance in a negative way. New designs for hearing protectors to improve integration and comfort are being developed.

The group listed a number of properties to consider when developing new footwear for cold climates:

- suitability for cold climate
- slipping
- sole materials, design
- ergonomics
- plastic toe cup
- function in -30C
- removal in the case of injury

**Group 5: Ways to increase the use of PPE from the technical and organisational point of view**

Not only availability of high qualitative PPE (e.g. through "CE" standardisation) is important, but also the knowledge of how to select PPE correctly (suitable specifications and parameters).

Unlike big companies any other users have not the expertise for selection and need recommendations on how to select PPE. National or regional guidelines per employer group should be elaborated by councils where employers, workers



self-employed and authorities participate. Special advice of researchers and representatives of trade unions, industrial organisations and safety authorities should also be heard in the process of preparing the recommendations. Producers and dealers should inform the users on the properties of PPE, to which purpose the PPE is made and how to use them.

The group suggested a market control of PPE which should involve:

- pre-market control (national level)
- monitoring and control of the products on the market (national level)
- corrective action by testing labs, jointly contributions by authorities and manufacturers to promote faster and less costly procedures (national level)
- both networks for passing information on unsuitable products (national and international levels).

Safety and health should be integrated into the regular (day to day) management and work. Occupational health services, labour inspectors or others who have direct contacts with workers and employers should assure transfer of information on PPE from workplaces to researchers, safety and health organisations and other concerned bodies.

Incentives and penalties to promote use of PPE to consider:

- special accident insurance rates which depend on the real compensation cost;
- low rates to cover certain worker groups (e.g. contractors, farmers);
- reduced compensation for the injured in case of neglect and misbehaviour;
- contractors should cover their business risk e.i. conscious risk taking.

#### Group 6: Ways to increase the use of PPE through changes in attitudes

When identifying the factors which influence the attitude towards the use of PPE the group made a distinction between the workers, the supervisors, the managing level and the contractors/self-employed.

At the worker level, the policy of who will pay for the gear was considered as an important factor influencing the worker's attitude towards PPE. Moreover his awareness of PPE, his personal accident record, his attitude towards supervisors, comfort of PPE, the influence of unions and collective agreement and his professional image ("loggers are tough guys") were also considered as important.

At the supervisor level, one important factor is the legal framework regarding his/her responsibility. Good working relation with the workers and awareness of conditions and hazards associated with forestry, good knowledge about PPE and a personal commitment are example of other weighty factors in this respect.

The attitude towards PPE at the managing level is very much reflected by the company's policy and the legal framework regarding its responsibilities. Knowledge of the consequences of injuries regarding productivity and profitability is an important factor that affects the managers commitment and willingness.

At the level of contractors, self employed workers, farmers and forest owners the cost of PPE could be of crucial importance especially if the cost of PPE is high in comparison with the cost of work. Other factors considered as important were: legislation, tax facilities, contract conditions, knowledge/education, traditions and cultural aspects.

To improve the use of PPE and avoid risk behaviour the group suggested that the worker should be informed of the possible consequences of risk behaviour, both physical and economical. This should be brought forward to the worker in a positive way not as a threat. The group further suggested an integrated approach (education-method-use of machines and PPE) produced jointly by the employers, workers and manufacturers.

Competent systems of work guidance with instructors were considered as an effective measure for training/education and to improve the feedback. The group stressed the importance of an adapted wage system since different types of work could be more or less suitable for piece rates in respect of working safety.

At the level of supervisors and management an improvement of legislation could improve the use of PPE e.g. when the employer is compelled to provide PPE free of charge. Safety aspects and the use of PPE should always be well integrated in the regular management work e.i. planning, education, operations, incentives and balancing of the books (feedback on the influence in PPE on productivity and rentability). Management should assess the use of PPE by the workers, then monitor it and make regular follow-up assessments. Another possibility well worth considering is the use of mass media in order to educate and change the image of forestry work in society.

Furthermore the group suggested that a certifications system for contractors and a tax deduction system for the cost of PPE should be established.

**Annex III**

**Abstracts of the POSTER SESSION, 30 June 1994  
Hannu Tapola, Finland**

**1. REQUIREMENTS FOR OPTIMAL PROTECTIVE CLOTHING FOR FOREST WORK, Ms. T. Risikko (Finland)**

In the jacket developed the location and construction of the vents and the collar improve the ventilation, while preventing the local cooling of the skin. In test person measurements the total insulation of the clothing developed was on average 0,3 clo lower than the total insulation of the commonly used clothing. This reduced heat stress and sweating during the heaviest work phases. On average 25 % less moisture condensated in the new gear than in the commonly used clothing.

**2. OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY SITUATION IN ESTONIAN FORESTRY, Mr. V. Beilmann (Estonia)**

The poster presented four topics: 1. Industrial safety regulations and legislation (ISR); 2. Industrial hygiene (working conditions) (IH); 3. Safety regulations and means (SR); 4. Fire prevention and fire fighting (FP).

Two to three years ago ISR in Estonia were similar to those in the republics of the Soviet Union. Now, during the years of the independence, new laws and regulations have gradually been established, but they are not working very well. One of the reasons is the economical situation in Estonia.

The main health risks are noise, vibration, low temperature combined with wind and rainfall, which cause hearing disturbances, vibration disease and pain in the lower back.

**3. OCCUPATIONAL HEALTH AND SAFETY IN A BIRZHAI FOREST ENTERPRISE Mr. R. Gaudiesius (Lithuania)**

Management is responsible for occupational health and safety (OSH) within a company. A director of OSH is responsible for implementation. All workers are required to attend a work guidance course before starting their job. Workers are also required to attend courses when new safety at work regulations come into effect; a worker changes his job; a worker has poor knowledge of OSH; and following an accident when the OSH committee is required to hold an enquiry. Each year, workers spend 10 hours studying occupational health and safety issues. Workers receive free work clothes and foot wear.

**4. EVALUATION OF THE EFFICIENCY AND COMFORT OF PROTECTIVE CLOTHING DURING PESTICIDE SPRAYING, Mr. J. Kangas (Finland)**

In this study the perceived wearing comfort and the protective ability of clothing materials used for protective clothes in pesticide work in the forest were tested. The break-through times and penetration rates of fenoxycarboxylic acids for nine woven fabrics and three non-woven materials were determined in the laboratory. Five healthy men worked with a brush saw device (BSD) and four with the ultralow-volume (ULV) sprayer in the study. The exposure of the workers to

phenoxy acids was evaluated by determining the content of phenoxy acids in urine. On the basis of the questionnaire and the test, the prototype suit and Gore-Tex proved to be the best protective suits.

**5. THE PSYCHOLOGICAL REASONS FOR LOGGING ACCIDENTS, Mrs. K. Kanninen (Finland)**

Data for the study were obtained through a postal questionnaire, accident reports and personal interviews with accident victims. Instead of the conventional classification based on work stage, the accidents were examined from the viewpoint of the event leading to the accidents.

Being sufficiently homogenous, this new classification facilitated the examination of accidents from a new perspective: that of internal models based on cognitive psychology. The theory of the internal models describes the normal work activity of the forest worker, the changes taking place with experience in his activities and reasons for them and the creation of risk situations. The study benefits occupational safety measures in logging work by providing a coherent, logical explanatory basis for the occurrence of different kinds of logging accidents, and for making proposals for accident prevention measures.

**6. THE INFLUENCE OF SAFETY GLOVES ON THE TRANSMISSION OF VIBRATION, Mr. Z. Kárpáti (Hungary)**

Among Hungarian forest workers the white finger disease is a serious problem. Forestry companies now use independent contractors. Most beginner contractors have saws in bad technical conditions and with a high level of vibration. The operators must use anti-vibration gloves. The present study suggests, however, that some gloves may even increase the vibration.

**7. STRESS AND MENTAL STRAIN IN OCCUPATIONAL GROUPS IN FORESTRY, Mr. T. Klen (Finland)**

The most prominent stressors were work pressure, the mental load of work, role ambiguity, a poor organizational climate and discrepancies, mobbing, malfunctions in work organization and structural changes of employers. A feeling of being mentally stressed was highest among the graduated foresters, followed by forest foremen, machine operators, machine entrepreneurs and lumber-jacks. The symptoms were most prevalent among the entrepreneurs, followed by foremen, lumber-jacks, machine operators and graduate foresters.

**8. EXPERT SYSTEM FOR SAFETY INSPECTION IN LOGGING, Mr. T. Leinonen (Finland)**

The aim of this study was to examine the tools and technologies that are available for creating knowledge-based systems. The study concludes that suitable technology is available to build a PC-based ergonomic and safety inspection expert system for logging.

**9. WORKERS' EXPOSURE TO PERMETRIN IN TREATMENT AGAINST PINE WEEVIL IN A NURSERY, Mrs. P. Manninen (Finland)**

Workers' exposure to permetrin was low compared to the limit values. In air samples the occupational exposure limit value for permetrin in Finland is

5 mg/m<sup>3</sup>. The exposure of the workers was far below that value in the occupational hygienic measurements. However, the exposure was highest in the dilution phase. The concentrations of the metabolites of permethrin in the urine samples taken after work shift were below 0.05 mg/dm<sup>3</sup>. However, the contamination of hands and protective clothing proved that proper use of personal protective equipment is necessary, especially in the dilution phase. Workers' symptoms during the work were rare, but typical to synthetic pyrethroids (itching on the face). The exposure can be reduced by changing powder to liquid.

**10. THERMAL COMFORT OF TIMBERJACKS' CLOTHING STUDIED WITH A SWEATING THERMAL MANIKIN, Mrs. H. Laamanen (Finland)**

Within a Scandinavian joint project, a sweating thermal manikin was constructed for more realistic studies of heat and moisture transmission through clothing. Timberjacks' protective garment were made in 3 different materials:

- 100% polyester fabric; breathable, not watertight;
- Microporous film laminate; breathable, watertight;
- Polyurethane coated fabric; non-breathable, watertight.

Measurements of thermal insulation and water vapour permeability were made in combinations with underwear and a thermodress with different sweating levels and in different environment temperatures. Changes in thermal insulation due to condensation in the clothing, evaporative and wetting effect of sweating on the heat loss, condensation in the different clothing layers and other results from the study are discussed.

**11. MUSCULOSKELETAL CAPACITY OF FOREST TRACTOR DRIVERS, Mrs. N. Nevala-Puranen (Finland)**

The aim of this study was to analyse the musculoskeletal capacity and leisure time physical activity of forest tractor drivers. The range of back mobility was smaller in the older age group. In the sit-up test, the younger subjects made 36±12 maximal repetitions compared to 31±11 made by the older. Thirteen percent of the subjects exercised at least three times a week, while 55% exercised less than once a week. Forest tractor drivers spent less time in physical activity and were more often overweight than the average Finnish adult population. The drivers should be motivated to increase their physical activity habits for preventing overweight and musculoskeletal troubles and developing musculoskeletal capacity to cope with straining work.

**12. PERSONNEL PROTECTIVE GEAR IN FORESTRY WORK IN TANZANIA, Mr. G.F. Nganyagwa (Tanzania)**

Tanzania adheres to codes and rules on personnel protective gear for forest workers. Most of the protective gear currently in use in the country have come through donor countries, ILO, FAO/UNDP projects.

Although the gear has been tested and proved most suitable for forest workers in developed countries, some has proved uncomfortable in certain conditions, e.g: overalls in hot season and safety helmets with ear protectors that sometimes isolate the operator from other workers. However, adoption of the equipment has improved forest work safety.

**13. RECOMMENDATIONS FOR PERIODICAL HEALTH EXAMINATIONS OF FOREST WORKERS, Mr. J. Nuutinen (Finland)**

According to the law of occupational health, periodical health examinations should be organized for forest workers. The health examinations are repeated every third year below 40 years of age and every second year at the age of 40 or older. The health examination includes an interview and an examination by an occupational health nurse (OHN) and a clinical check-up by a physician. Symptoms, living habits, smoking and alcohol consumption are checked. Audiometry, visual tests, blood pressure measurement and maximal isometric handgrip test are performed by OHN. Blood samples are taken to investigate cholesterol, HDL-cholesterol and triglycerides and a urine sample is checked for glucose. A part of health examination is the evaluation of the status of circulatory, muscular and mental system. Clinical examination focuses on syndroms of work related diseases. The need of rehabilitation is assessed by a physician. Information on clothing, protective equipment, ergonomy and dietary habits is given to forest workers during health examination.

**14. CLIMATE IN THE CABIN OF FORESTRY TRACTORS, Mr. K. Ojanen (Finland)**

During the summer, the radiant temperature was the most important heat factor and the heat in the cabin exceeded recommendations. In winter conditions, the air in the cabin was warm enough, but the temperature difference between neck and ankle levels was higher than recommended. The relative humidity of the air was good in summer, but much too low in winter time. The air speed in summer was in some cases higher than recommended.

**15. SEAT ADJUSTMENTS IN FOREST TRACTORS, Ms. M. Perkiö (Finland)**

The aim of this study was to clarify the ergonomics of forest tractor drivers sitting circumstances. Drivers were interviewed individually and examined by a physiotherapist. A technician assessed the ergonomics of the seats in their tractors, including height and inclination of the seat, inclination of the back rest, and the stiffness of the spring. The seat adjustment had been kept unchanged for two weeks by 58 % of the drivers. The accessory lumbar support had been used by 24 % of the drivers. The two weeks intervention period was too short to get used to a new sitting position and to study the effects of set adjustments to low-back and neck-shoulder symptoms.

**16. COLD EXPERIENCED BY FORESTRY WORKERS, Mrs. S. Rissanen (Finland)**

According to the results of the inquiry, 27 % of the workers indicated musculoskeletal disorders (MS), 14 % disorders of the circulatory system (C) and 4 % respiratory diseases (R). Cold was felt to increase physical strain of work in 52 % of the healthy group (H), in 62 % of the MS, in 72 % of the C and in 93 % of the R group. The C and R groups experienced cold problems to start at 2-7° C higher ambient temperature than healthy workers. The forestry workers with health problems, e.g. hypertension and respiratory diseases, seem to be more sensitive to cold than healthy workers.

**17. SAFETY PROBLEMS IN LOGGING IN NEPAL, Mr. R.B. Shrestha (Nepal)**

In Nepal workers still work without any safety equipment. They do follow safety measures but those are not ergonomically sound. There is no safety legislation obliging them to wear PPE. Now it is urgent to think about wearing safety equipment at work.

**18. MARKET CONTROL OF PERSONAL PROTECTIVE EQUIPMENT IN FINLAND, Mr H. Tapola (Finland)**

Product control of PPE consists of primary control and market control. Primary control is the responsibility of the manufacturer who has to carry out premarket control so as to ensure that the products meet health and safety requirements laid down in the relevant directives. Market control is the responsibility of safety authorities, which carry out product surveillance on the market. In addition, they receive complaints from users. Six types of helmets made of ABS, both new and in use, were submitted for testing with the following results:

- any helmet more than two years of age did not pass the penetration test;
- samples of helmets of three types less than two years old did not pass either;
- marking and instructions for use were in most cases insufficient;
- some workers' protection sets included a hearing protector not intended for forest work.

**19. A MODEL FOR THE WORK OF THE SINGLE-GRIP HARVESTER OPERATOR, Mrs. T.Tolvanen-Sikanen (Finland)**

The aims of this study are (1) to make an information - action - mental load - model for the work of a single-grip harvester operator and (2) to find the optimal distribution of work between a machine and an operator and between supervision activities and an operator.

The results of the study can be applied in developing work distribution, automatic operations and control devices, in describing and understanding of the learning process, in the training of operators and in operators' work safety.

**20. THE CAMPAIGN "WORKING SAFELY IS BEST, EVEN WHEN WOOD IS UNDER STRESS", Mr. T.L. Van Dijk (The Netherlands)**

In certain situations work in forest and nature areas may entail greater risks than usual. This is particularly the case in the processing of trees that have been damaged by storm. The presentation comprises three main information sources:

1. an English-language version of the video "Wood under stress";
2. an information exhibit offering a brief explanation of the current campaign;
3. a folder containing a summary of the campaign as well as a description of such topics as: the major causes of accidents, how to minimize risks and further details concerning the application of various practical techniques.

**21. SAFETY OF COMMUNICATION RADIO SYSTEM FOR FORESTRY AND AGRICULTURE, Mr. O. Dammerud (Norway)**

The safety and communication radio system is based on VHF-frequencies. Everyone occupied in forestry and agriculture is able to get a licence. The system can in some way be compared to the VHF radio system but there is no connection with the telephone net. The operation of the system is independent of free lines on telephone net. The radio system can as a minimum be used with two radio units by a farmer and his wife. The more advanced system is established as a 'radio party' in a local area by several users, forest companies, farmers or hunters who are connected to a central listening station. It is important that someone in the system always knows the position of the worker who carries the radio unit. To make the rescue party or ambulance able to find the injured person in a short time, the forest roads shall be marked with the radio users identification number on signs in crossroads on the way in the field. This safety and communication radio system has saved several lives of forest workers in Norway and is an efficient device to get assistance of any kind out in the field.