REPORT OF THE COMMITEE
ON

Carbon Tetra Chloride (CTC) Phase out from Power Sector

Ministry of Power
Central Electricity Authority
New Delhi
September 2009

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EXECUTIVE SUMMARY

In power sector, Carbon Tetra Chloride (CTC) is being used mainly to clean the contacts of electrical equipments, deposits on insulators, motor insulation and transformer windings etc. The chemical formula of CTC is CCl_4. However, CTC is an ozone depleting substance (ODS) and therefore harmful to the global environment.

To protect the ozone layer, countries across the globe came together and drew up a global agreement - **the Montreal Protocol**. This international treaty aligns developing and developed countries in the mutual pursuit of phasing out Ozone Depleting Systems (ODS). India is one of the 130 countries who are signatory to Montréal protocol.

Under this agreement India has committed to phase-out the use of CTC **completely by 31st December 2009.**

A committee was constituted in Central Electricity Authority for phasing out the CTC from power sector.

The data collected from various power utilities engaged in power generation, transmission and distribution has revealed that most of the power utilities have already discontinued use of CTC and Environment friendly alternatives to CTC are being used.

CHAPTER 1
INTRODUCTION

1.0 Introduction

Carbon tetrachloride (CTC) is a chemical widely used in industries as cleaning agent. In power sector, CTC is being used mainly to clean the contacts of electrical equipments etc. The chemical formula of CTC is CCl_4. It is a colorless liquid with a "sweet" smell that can be detected at low levels.

However, CTC is an ozone depleting substance (ODS) like chlorofluorocarbons (CFCs). CTC is mainly responsible for destroying ozone layer which protects life on our planet from harmful ultraviolet-B (UV-B) rays. Exposure to harmful ultraviolet rays can increase the incidence of various types of skin diseases including cancer, eye cataract.

CTC exposure to high concentrations can severely affect the central nervous system and can permanently damage the liver and kidneys and prolonged exposure can lead a person to coma and even death.

Also CTC is one of the green house gas with a global warming potential (GWP) of about 1,400. Green Houses Gases are mainly attributed to climate change.

1.1 International Efforts

1.1.1 Montréal Protocol

In order to protect the ozone layer, countries across the globe came together and drew up a global agreement - the Montreal Protocol. This international treaty aligns developing and developed countries in the mutual pursuit of phasing out Ozone Depleting Systems (ODS). Montreal protocol was signed by more than 190 countries to phase out production and consumption of CTC and other ozone depleting substances. India is also a signatory to Montréal protocol. Under this

agreement India has committed to phase-out the use of CTC **completely by 31st December 2009.**

The list of chemicals proposed to be phased out is as below :

Table 1: - Compound and phase-out schedule of substances regulated by Montréal protocol

Compound	Ozone Depleting Potential (ODP)	Complete phase out for developed countries by 1st Jan of	Complete phase out for article 5 countries by 1st Jan of
Bromochloromethane	0.12	2002	n/a
Carbon Tetrachloride (CTC)	1.1	1996	2010
Chlorofluorocarbons (CFCs)	0.6-1.0	1996	2010
Halons	3-10	1994	2010
Hydrobromofluorocarbons (HBFC)	0.1-14	2005	2010
Hydrochlorofluorocarbons (HCFC)	0.05	2020	2030
Methyl Bromide	0.6	2005	2015
1.1.1-Trichloroethane	0.1	1996	2015

Source: GTZ Booklet

1.2 Implications for India

Since September 1992, India is a party to the Montreal Protocol and is listed as an Article-5 country (developing country). Based on the average production and consumption of the baseline years 1998 to 2000, the phase-out schedule for CTC stipulates that, both production and consumption be reduced by 85% by January 1, 2005. CTC has to be phased out completely by January 1, 2010. In this task Government of India is assisted by World Bank, UNIDO, UNDP and bilateral partners deputed by France, Germany and Japan.

Table 2: Reduction targets for India

Reduction targets	
On January 1, 2005	Reduction by 85% to 1,726 MT
On January 1, 2010	Reduction by 100% to 0 MT
Baseline consumption: 11,505 MT of CTC per annum	

1.3 National Efforts for phasing out CTC in the country

The Ozone Cell in the Ministry of Environment and Forests is the central agency coordinating the phase-out of CTC. The Cell had put in place a regulatory frame work and national phase-out plan to ensure domestic CTC production and imports progressively decrease in compliance with national targets.

Also under GTZ ,German Technical Cooperation, a sectoral programme named GTZ-Proklima has been initiated as the largest bilateral partner of the Multilateral Fund of the Montreal Protocol. GTZ – Proklima is providing full support to Indian industries in the textiles and metal cleaning sector (including electrical applications) for smooth transition to a CTC free world under overall coordination of Ozone Cell, Ministry of Environment and Forest.

India has a extremely good track record for fulfilling its obligations under Montréal Protocol. Ozone cell has been created in Ministry of Environment and forest to monitor the CTC phase out plan. It is estimated that already 85% of CTC consumption has been phased out by the year 2005.

CHAPTER 2
CTC USE IN POWER SECTOR

2.0 Usage of CTC in Power sector

CTC is commonly used in cleaning of electrical applications. Some of the equipment like generators, motors and insulators of high voltage transmission are being cleaned with CTC. Main areas of usage in power sector are:

a) Electrical Contacts: Carbon is deposited over time due to sparking in electrical contacts due to connection and disconnection. These deposits can adversely affect the performance of the electrical contacts and therefore cleaning of these contact becomes necessary and is an integral part of preventive maintenance in power industry.

b) Insulators: Deposits of contaminants like pollutants on high voltage insulators can cause dielectric breakdown resulting in arcing causing equipment damage and power outages

c) Generators/Motors:

Generators and Motors in power plants are cleaned regularly to remove the dirt deposited on the insulation and other parts. These deposits can lead to failure of insulation causing equipment failure.

d) Transformers: Transformer windings are cleaned using CTC to remove various deposits

2.1 Phasing out of CTC in power sector

The use of CTC is also to be phased out by 1st January 2010 in Power Sector to fulfill the requirement of Montreal Protocol. To suggest ways of achieving this, a committee was setup under the Chairmanship of Chief Engineer (IRP), Central Electricity Authority with representatives from various power sector companies including private and central sector, GTZ-Proklima, and Ozone Cell, MOEF for

phasing out use of solvent Carbon tetrachloride (CTC) from Power sector vide CEA letter dated 31.01.2009 (**copy enclosed at Annexure-A**).

The first meeting of the committee was held on 2.4.2009. Various issues relating to CTC phase out from Power sector were discussed in the meeting. It was suggested by CEA that a questionnaire be circulated to all stakeholders in power sector to estimate the amount of CTC being used and the alternatives being used by the power industry. All the members were requested to get more information on CTC usage in their organisations and send the information to the Committee. The GTZ representative was requested to find out the safer alternative chemicals in place of CTC in power sector and their experience in EU.

The 2nd meeting of the committee was held on 15.5.2009. The Committee members were apprised of the feedback received from some of the Power utilities regarding CTC usage. Most of the utilities had already discontinued the use of CTC and were using various other solvents as an alternative to CTC. It was decided that GTZ will send a sample questionnaire to CEA for onward transmission to various power utilities to get full details of the alternative being used by them. It was also decided that GTZ will provide copies of the booklet prepared by them on selection and safe use of alternatives to CTC in electrical applications for circulation to power utilities along with the questionnaire. The copies of the minutes of meetings are attached as **Annexure-B**. A copy of the questionnaire is attached as **Annexure-C**. A copy of the booklet prepared by GTZ-Proklima on Selection and safe use of alternatives to CTC in Electrical applications is enclosed as **Annexure D**.

2.2 Alternatives of CTC used in power sector

Selecting suitable alternatives, especially safer ones, is not an easy task. There is no single alternative which can replace CTC in all its applications and in the absence of sufficient information, enterprises may substitute CTC with an even more hazardous substance such as Trichloroethylene or Benzene.

No alternative is ideal in all regards and each one has certain advantages and disadvantages. In order to address environmental, health and safety concerns without compromising on quality and cost effectiveness, any substitute for CTC should meet the following criteria:

- It should be a non-ozone-depleting substance (non-ODS)
- It should have good cleaning efficacy
- It should have low toxicity
- It should have High Dielectric strength
- It should be compatible with insulation material (should not damage it)
- It should not leave any residue
- It should have equal or lower cost compared to CTC
- It should be locally available
- It should be non carcinogenic

Following alternative chemicals have been suggested by GTZ and other organizations based on their usage in EU:

Suggested Alternatives	*Application*
Small sized contacts	
Acetone	Cleaning of silver coated contacts of control devices. May react with insulation material used in the power sector. Usage limited to **'offline'** operations.
Isopropyl Alcohol (IPA)	Contact cleaning. Usage limited to **'offline'** operations.?
Mineral Turpentine	Cleaning of contactor assemblies in the **power sector**. Usage limited to **'offline'** operations.
Methylene Dichloride (MDC)	Used for online operations.?
Perchloroethylene (PCE)	Contact cleaning in the **power sector**.

Larger contacts such as in switchyards	
Methylene Dichloride (MDC)	Cleaning of carbon deposits on breakers in the switchyard in the power sector.?
Motor and generator cleaning	
Perchloroethylene (PCE)	Cleaning & maintenance of generators, motors, bushings, breakers and armatures. Usage limited to 'offline' operations.
Mineral Turpentine	
Electronics and Instrumentation cleaning	
Isopropyl Alcohol (IPA)	Cleaning of printed circuit boards.?

It can be seen from the GTZ booklet that most of these are highly flammable and some are injurious to health also. Further no single substance is suitable for all purposes.

2.3 Process Alternatives

There are various alternative processes also which could also be used

a. Compressed air can also be used to remove dust and light dirt from the exterior and interior of a motor. The air should be dried to remove the moisture content. Compressed air should never be used when metallic dusts such as copper, iron or carbon are present.

b. Carbon dioxide (CO_2 or dry ice) particle media blasting is a technique that can be used to clean energized power distribution equipment. Contaminants are removed by the impact of the CO_2 particle. The dry ice shears and lifts the contaminant off the surface with no very minimal damage and leaves no residual waste. This shearing or lifting force is caused by the sublimation (direct transition from solid phase to gaseous phase) of the dry-ice particles resulting in a sudden 400-fold increase in volume of the gas directed along the plane of the substrate. The contaminant is swept up, or in the case of outdoor switches, blown out of the enclosure. The released CO_2 gas is a naturally occurring atmospheric compound and presents no significant environmental concern.

CHAPTER 3
STATUS IN INDIAN POWER SECTOR

3.0 Status of CTC Usage in Power Utilities

The responses received from various power utilities have been compiled and are attached as **Annexure- E**.

30 utilities responded to the questionnaire on CTC usage circulated by CEA to all the Power Utilities. Only 4 of them are reportedly using CTC for various applications, the maximum quantity being used is 25 litres / year by Sanjay Gandhi TPS of MPPGCL.

It is evident from the data collected from various power utilities that already many power utilities have phased out usage of CTC and they have started using various alternatives to CTC.

Some of the solvents/cleaning agents being used as an alternative to CTC are given in table 3.

Table 3 :- Alternative solvents being used in power Utilities

SNo.	Alternatives
1.	Propanel GR
2.	Stanvac spray
3.	Kard Kleen
4.	Zorilec 88 liquid/Zorrik 88 spray
5.	OKs 2621 T/oks 2621/2 spray
6.	Contact cleaner KLI-NIT CT-2
7.	Molykote S-1002
8.	CRC 2 – 26
9.	Acetone
10.	Benzene/Toulene
11.	Super Electro Safe Z-136
12.	Methanol
13.	WD-40
14.	Petrol, Diesel, Kerosene
15.	Isopropyl Alcohol
16.	Dc 2-26
17.	Rustolin
18.	Mineral Turpentine oil (M.T.O.)
19.	Rust Hick 631

Many of above are trade names of the alternative substances and exact chemical composition is not known. Long term effects of these on equipment, environment and human beings are also not well documented.

CHAPTER 4
CONCLUSIONS

4.0 CONCLUSIONS

1. It is observed that many of the power utilities are already aware of the need to phase out CTC and they have started using alternatives. However it is not clear how safe the new products are? Therefore, a Material Safety Data Sheet (MSDS) should be requested from the suppliers.

   It is also considered essential that a detailed study be carried out by agencies like Ozone Cell, GTZ and UNIDO to find out whether these products meet the criteria set for substitutes of CTC.

2. Though a number of utilities have opted out of CTC, some are still using it. Awareness campaign jointly by CEA, Ozone cell and GTZ by way of regional workshops /lectures could help spread the message.

3. It is observed that any single alternative can not replace CTC, therefore alternatives must be selected based on the application.

4. Power utilities must ensure that contractors engaged by them should also not use CTC for any application and such a condition be made part of the contract document.

5 Booklet prepared by GTZ on selection and safe use of alternatives to CTC in electrical applications may be made available to all power utilities. CEA should send an advisory to all utilities about CTC phase out and very useful publications issues by GTZ in this regard. A copy of GTZ booklet be enclosed with each letter. (it can be downloaded for free from the project's website www.ctc-phaseout.org).

6 Ozone Cell , in MOEF is monitoring the production and use of CTC in India but the fact that CTC is still available in market for use in Power Plants suggests that end use of CTC should also be monitored by Ozone Cell.

ANNEXURES

ANNEXURE-A

GOVERNMENT OF INDIA
CENTRAL ELECTRICITY AUTHORITY
CONSERVATION & EFFICIENCY DIVISION
SEWA BHAWAN, RAMAKRISHNA PURAM
NEW DELHI-110066 [ISO: 9001-2000]

No.CEA/Plg/C&E/ENV16(CTC)/2009/450-460 Dated: 8.02.2009

To
As per list

Subject: CTC phase-out plan for power sector

Sir,

Chairman, CEA has constituted a committee consisting of following representatives from various organisations for phasing out the use of solvent Carbon Tetra Chloride (CTC) from Power Sector:

1.	CE (IRP), CEA	-	Chairman
2.	CE (C&E), CEA	-	Member
3.	Representative of NTPC	-	Member
4.	Representative of DVC	-	Member
5.	Representative of APGENCO	-	Member
6.	Representative of MAHAGENCO	-	Member
7.	Representative of RRVUNL	-	Member
8.	Representative of Tata Power Co.	-	Member
9.	Representative of Reliance Power Co.	-	Member
10.	Representative of NPTI	-	Member
11.	Representative of GTZ	-	Member
12.	Representative of “Ozone Cell” (MOEF)		Member

You are requested to nominate a senior officer from your organisation for the above mentioned committee. We shall be grateful if confirmation in this regard is sent to us by fax or by e-mail to ID cecndecea@gmail.com.

Yours faithfully,
sd/-
(Amarjeet Singh)
Chief Engineer (C&E)
Tele/Fax 26102069

Copy to: Chief Engineer (IRP), CEA

ANNEXURE-B

GOVERNMENT OF INDIA
CENTRAL ELECTRICITY AUTHORITY
CONSERVATION & EFFICIENCY DIVISION
SEWA BHAWAN, RAMAKRISHNA PURAM
NEW DELHI-110066

[ISO: 9001-2000]

No.CEA/Plg/C&E/ENV16(CTC)/2009/ Dated: 8.4.2009

Subject : Minutes of 1st Meeting of the committee on Carbon Tetra Chloride (CTC) phase out plan for Power sector held on 2.4.2009

Enclosed please find the Minutes of the 1st meeting of Committee for CTC phase out plan for the power sector held on 2.4.2009 at Central Electricity Authority, New Delhi for further necessary action at your end.

Encl: as above

sd/-
(Amarjeet Singh)
Chief Engineer(C&E) &
Member Secretary to the committee
Tele: 26102069

1. Shri A.S. Bakshi
   Chief Engineer (IRP)
   Central Electricity Authority
   Sewa Bhawan, Ramakrishna Puram
   New Delhi-110066
2. Shri V.K. Agarwal
   AGM (OS-Electrical)
   NTPC, EOC
   Sector 24, Noida (U.P.) – 201 301
   Fax: 0120-2410344
3. Shri C. Bhattacharya
   Asstt. Director (Tech./Faculty)
   National Power Training Institute (Eastern Region)
   City Centre, Durgapur
   West Bengal – 713 216, Fax: 0343-2545888
4. Shri Shankar Nath Bandopadhyay
   Dy. Chief Engineer (C), EM&PC
   Damodar Valley Corporation
   DVC Towers, 10th Floor

VIP Road, Kolkata – 700 054 (W.B.),Fax: 033-23556042

5. Shri M. Venkateswara Rao
Chief Chemist
O/o Chief Engineer (O&M)
Kothagudem Thermal Power Station
Paloncha, Khammam- 507 115 ,Fax: 040- 23499242

6. Shri S.J. Jadhav
Chief General Manager (Works)
MAHAGENCO
IIIrd Floor, Prakashgad, Plot No.G-9
Prof. A.K. Marg, Bandra (E)
Mumbai – 400 051,Fax: 022-26473896

7. Shri A.K. Purohit
Dy. Chief Engineer (PPM)
Rajasthan Rajya Vidyut Utpadan Nigam Ltd.
Vidyut Bhawan, Jan Path, Jyoti Nagar
Jaipur – 302 005 (Rajasthan)

8. Mr. Markus Wypior
Project Manager
Proklima International
A-33, Gulmohar Park
New Delhi – 110 049

9. Mr. Jens Burgtorf
Director(IGEN)
GTZ, Bureau of Energy Efficiency
Sewa Bhawan, R.K.Puram,
New Delhi-110066

Copy also forwarded with a request to kindly nominate a suitable officers from your organization for the above committee as already requested:

1. Additional Secretary (Ozone cell)
Ministry of Environment & Forest
Prayvaran Bhawan, CGO Complex,
Lodhi Road, New Delhi-110003

2. Shri Adi Engineer
Tata Power Co. Ltd.
Bombay House, 24 Homi Modi Street
Fort, Mumbai,
Maharashtra – 400001

3. Shri S.L. Rao
Reliance Power Ltd.
H-Block, First Floor
Dhirubhai Ambani Knowledge City
Navi Mumbai,
Maharashtra – 400710

Minutes of the 1st meeting of Committee for CTC phase out plan for the power sector held on 2.4.2009

Shri A.S.Bakshi, Chief Engineer(IRP),CEA welcomed the members of the committee on CTC phase out from power sector He informed that India is signatory to Montreal Protocol under which production and consumption of carbon tetrachloride (CTC) which is harmful to ozone layer has to be stopped by 1st Jan,2010. He also informed that CTC in power sector is being used mainly in cleaning of electrical contacts.

Shri V. K.Agarwal, AGM,NTPC informed that NTPC has already phased out use of CTC in their power stations. He informed that NTPC stations are using acetone and propriety item CRC226 instead of CTC and its results are encouraging.

Chief Engineer(IRP) raised the issue of safety of various alternatives. Representative of NPTI, Durgapur suggested safety data sheet can be prepared by M/s NEERI, Nagpur, if required.

Chief Engineer(IRP) requested GTZ representative Mr Jens Burgtorf to find out the alternatives chemicals in place of CTC in power sector and their safety experience in EU.

Shri Amarjeet Singh, Chief Engineer (C&E) suggested that a questionnaire can be circulated to all stakeholders in power sector to estimate the amount of CTC being used and alternative chemicals being used by power industry.

Representative of APGENCO informed that small quantity of about 50 litres per annum is being used at Kothagudm thermal power station. He informed that at some plants of APGENCO are using acetone in place of CTC. The acetone is available in various grades and is almost double the cost of CTC.

CE(IRP) suggested that CEA officers can meet officials of Ozone Cell, MOEF to get update on the steps being taken by Government of India to stop usage of CTC in India.

CE(IRP) in his concluding remarks requested all the members to get more information on the CTC usage in their organization and send the information latest by 20th April,2009.

The meeting ended with vote of thanks to Chair.

List of participants is enclosed.

GOVERNMENT OF INDIA
CENTRAL ELECTRICITY AUTHORITY
CONSERVATION & EFFICIENCY DIVISION
SEWA BHAWAN, RAMAKRISHNA PURAM
NEW DELHI-110066

[ISO: 9001-2000]

No.CEA/Plg/C&E/ENV16(CTC)/2009/ Dated: 22.5.2009

Subject : Minutes of 2st Meeting of the committee on Carbon Tetra Chloride (CTC) phase out plan for Power sector held on 15.5.2009

Enclosed please find the Minutes of the 2nd meeting of Committee for CTC phase out plan for the power sector held on 15.5.2009 at Central Electricity Authority, New Delhi for further necessary action at your end.

Encl: as above

-sd-
(Amarjeet Singh)
Chief Engineer(C&E) &
Member Secretary to the committee
Tele: 26102069

1. Shri A.S. Bakshi
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Vidyut Bhawan, Jan Path, Jyoti Nagar
Jaipur – 302 005 (Rajasthan)
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Project Manager
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A-33, Gulmohar Park
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3. Shri S.L. Rao
Reliance Power Ltd.
H-Block, First Floor
Dhirubhai Ambani Knowledge City
Navi Mumbai,
Maharashtra – 400710

Minutes of the 2st meeting of Committee for CTC phase out plan for the power sector held on 15.5.2009

Shri Amarjeet Singh, Chief Engineer(C & E),CEA welcomed the members of the committee on CTC phase out from power sector.

Chief Engineer(C & E), informed the members that a questionnaire was circulated to all the power generating utilities and replies received from them has indicated that use of CTC has already been discontinued in most of the power stations. Details of replies received from the power stations were circulated among the members.

Mr Markus Wypior, Manager, GTZ introduced Dr Mohunta and Shri **Ramasuhamanian** and Mr Mattew of GTZ who have worked on the studies to phase out CTC from different sector including power sector carried by GTZ.

A presentation on the work carried out by GTZ on finding CTC alternatives applicable to power sector was given. Also Dr Mohunta explained the methodology to mix two or more solvent to prepare a solvent having equivalent characteristics as that of CTC. He explained the various characteristics which are to be looked into before any alternative solvent can be selected.

Various solvent which can be used a s alternatives to CTC in power sector were discussed.

Chief Engineer (C&E) informed that based on the feedback from about 15 power generating stations, it is observed that most of the power generating stations have discontinued the usage of CTC and are using different alternatives. However, details and experiences with alternatives being used is still to be explored.. It was decided that GTZ will send the sample questionnaire to CEA for onward transmission to various utilities including power generating, transmission and distribution utilities to get the full details of the alternatives being used by them.

It was decided that the booklet prepared by GTZ on selection and safe use of alternatives to CTC in electrical applications may also be circulated to power utilities along with the questionnaire. GTZ to provide 100 copies of the booklet to CEA.

CE(C&E),CEA in his concluding remarks appreciated the efforts which have been put in by the team of GTZ experts.

The meeting ended with vote of thanks to Chair.

List of participants is enclosed.

ANNEXURE-C

Questionnaire on solvent electrical cleaning

Carbon tetrachloride (CTC) is being used for cleaning of electrical contacts, insulators, motors and generators during regular maintenance or when they are serviced. Since CTC is being phased-out because of its harmful impact on the ozone layer, many users have switched over to alternative solvents.

Most of the solvents have hazardous properties, hence it is important to know about the potential hazards of the solvent that you use and on the safety precautions to be taken. The lack of such information can and has caused accidents. Therefore it is necessary to check manufacturers' instructions and other reliable sources of information and assess whether the solvent that you use is safe or not and take necessary precautions to control and reduce risks.

We would like to make this basic information available on "safe use of solvents" in power sector. Please fill in the questionnaire and provide us with available data on the alternative that you use.

1	Brand name		Liquid	Spray
2	Name and address of manufacturer			
	Tel. No			
	Email or web address of manufacturer			
3	Please provide any other information available on the label or container	(Please attach a copy of the label of the bottle/can/barrel)		
4	Quantity of solvent used per annum			
5	Frequency of usage	(This is required to suggest necessary control measures.)		
6	Efficacy of the alternative being used	Excellent	Good	Satisfactory
7	Any effect on worker? (Strong odour, skin irritation etc.)			

Questionnaire on solvent electrical cleaning

Explanatory Note

Most of the solvents used for electrical cleaning have hazardous properties in the broadest sense, they could be inflammable, affect human health in long term and short term, cause temporary irritation, skin itching, etc. may be poisonous, cause environmental damage due to ozone depletion, green house warming, if let into water bodies and drains cause death of aquatic life. They may remain for long term in the surroundings causing any of the above effects over a period of time.
As solvents are organic substances they can catch fire the properties that describe the propensity to catch fire or explode are important and also the safe storage and mitigation of such hazards is important.
The lack of such information can and has caused accidents. Therefore the user should ensure for the sake of safety of personnel and plant that the basic information is available when he buys and uses the cleaning solvents.

1. Brand name
2. Ingredients, names , CAS no.
   2.1 A cleaning solvent can be single solvent or a mixture
   2.2 CAS No. is unique number that identifies every chemical and known commercial mixtures
3. Approximate % range for each
   3.1 This can be given as percentage range 10-30%, 5-15%
4. Propellant gases in case of spray cans
   4.1 In case of spray cans the solvent is spayed by a gas under pressure in the spay can. This gas can be carbon dioxide, hydrocarbon gases, fluorinated organic compounds, etc.
5. Properties, Flash point, LFL, UFL , either for each component or for the mixture
   5.1 Flash point is the minimum temperature at which vapour of the solvent will catch fire if a flame is shown
   5.2 LFL is the lower flammability that is the minimum volume% of solvent in air at room temp.(usually 25C) that will catch fire when exposed to a very low energy spark.
   5.3 UFL is upper flammability limit that is the maximum volume% of solvent in air at room temp.(usually25C)that will catch fire when exposed to very low energy spark
   5.4 Low energy spark could be a nail hitting an iron article, hammer hitting a nail or iron article, scrapping of boot nails on floor.
6. Human exposure data
   8.1 The exposure to solvents during cleaning can be through breathing, skin contact etc.
   8.2 The effect depends upon the concentration of the solvent in air and duration of contact.
   8.3 based on human and animal data the maximum safe concentration in air and the duration has been set.

8.4 The data available from USA is usually taken as standard,

8.5 The concentration is stated in parts per million or mg/M3 and the time of exposure in hours

7. Toxicity or human health effects

   7.1 Effects such as dizziness, breathing difficulty, central nervous system (CNS)depressant, eye irritation, skin itching, skin dehydration, liver poison, etc.

8. Environmental effects – ozone depleting potential (ODPS), green house warming potential (GWP)
9. Safety precaution during use

   9.1 The manufacturer should advise safe use, such as use of masks, gloves, conditions of ventilation, etc.

10. Safety precaution for storage

    10.1 storing away from hot surfaces, away from other flammable materials, etc.

11. Fire fighting

    11.1 type extinguisher, etc.

For more information read the solvent booklet issued by GTZ (can be downloaded under www.ctc-phaseout.org)

1	Brand name			Liquid	Spray
2	Address of manufacturer				
3	**Components**	CAS No.	B. P.	Flash point	LFL - UFL
	1.				
	2				
	3				
	4				
	5				
	6 Mixture if available	NA			
4	Propellant				
	1				
5	**Exposure data**	CAS No.			
	1.				
	2				
	3				
	4				
	5				
	6 Mixture if available	NA			
	7 Propellant				

Example

1	Brand name	XYZ		Liquid ~~Spray~~		
2	Address of manufacturer	ABC Company India				
3	**Composition**	CAS No.	Wt%	B.P. C	Flash point C	LFL - UFL Vol%
	1 Isohexane	107-83-5	>70	63-70	-23	1.25 - 7
	2 n-Hexane	110-54-3	<5	68	-22	1.25 -7
	3 Ethanol	64-17-5	<10	78	13	3.3 - 19
	4 Hydrotreated naphtha	64742-48-9	10-30	48-173	25	0.7 -6.0
	5					
	6 Mixture if available	NA		58 - 110	-5	Approx 1.2 - 15
4	Propellant					
	1 NIL					

5	**Exposure data Environmental data**	**CAS No.**	**ACGIH TLV mg/M3**	**OSHA TWA ppm**	**ODP**	**GWP years**
	1 Isohexane	107-83-5	1800	500	0	0
	2 n-Hexane	110-54-3	180	50	0	0
	3 Ethanol	64-17-5	**1900**	1000	0	0
	4 hydrotreated naphtha	64742-48-9		400	0	0
	5					
	6 Mixture if available	NA				
	7 Propellant					

6	Human health effects Eye contact, skin contact Inhalation, Ingestion, cancer	**Eye Contact**: Direct eye contact with vapors may cause eye irritation. Transient **Skin Contact**: Skin irritant. **Inhalation (Breathing)**: Excess inhalation can headache; narcosis; dizziness; drowsiness; irritation; unconsciousness; numbness; and lung irritation. **Ingestion (Swallowing)**: Excess can cause nausea; drowsiness, stupor; CNS depression; potential liver damage. **Carcinogenic Status**: NIL
7	First AID	**Eye Contact**: If eye irritation from exposure to vapors develops, move to fresh air, direct eye contact, flush with large quantity of water.If irritation persists, seek medical attention **Skin Contact**: Remove contaminated clothing; flush skin thoroughly with water. If irritation occurs, seek medical attention. **Inhalation (Breathing)**: If irritation of nose or throat develops, move to fresh air or difficulty in breathing seek medical If irritation

		Ingestion (Swallowing): Do not induce vomiting or give anything by mouth. If victim is drowsy or unconscious, place on the left side with head down. Do not leave victim unattended. Seek doctor's help.
8	Safety during use	**Respiratory Protection**: Normal ventilation adequate. **Protective Gloves**: For repeated or prolonged skin contact, the use of impermeable gloves is recommended e**ye Protection**: Eye protection is recommended, especially if the material is used in ways where it could splash in the eyes. **Other Protective Equipment**: A source of clean water be available in work area for flushing eyes and skin. Impervious clothing should be worn as needed.
9	Safety storage	Keep containers tightly closed. Keep containers cool, dry, and away from sources of ignition. Do not transport or store near heat sources All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.
10	Fire fighting	Dry chemical, Foam, water spray, or CO_2 **Special Procedures**: Wear full protective clothing, including self-contained, positive pressure or pressure-demand breathing apparatus. Use water spray to cool fire-exposed containers. **Unusual Hazards**: Vapors are heavier than air and can travel considerable distances to ignition sources to flash or explode.

Selection and safe use of alternatives to CTC

Electrical Applications

gtz PROKLIMA

On behalf of
Federal Ministry
for Economic Cooperation
and Development

On behalf of
FFEM

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Table of Contents

1. The Phase-out of CTC

1.1 About CTC

Carbon tetrachloride (CTC) is a solvent and cleaning agent used widely across many industry segments. Its high solvency power, low cost and the fact that it is non-flammable made it popular in many cleaning applications.

Although CTC is very popular, it is an ozone depleting substance (ODS) like chlorofluorocarbons (CFCs). It destroys the stratospheric ozone layer which protects life on our planet from harmful ultraviolet-B (UV-B) rays. It increases the incidence of skin cancer, eye cataract, suppresses the human immune system, reduces crop yields and affects aquatic life. Another adverse impact of CTC is its contribution to global warming. The global warming potential (GWP) of CTC is about 1,400 times higher than that of carbon dioxide (CO_2), the main greenhouse gas.

At the workplace CTC is an occupational health hazard. CTC is very toxic and is absorbed by the skin and also in the gastrointestinal and respiratory systems. CTC affects the central nervous system (CNS) severely, causing headache, weakness, drowsiness, nausea and vomiting. Inhalation of high levels can permanently damage the liver and kidneys. The severity of the effects depends on the route and frequency of exposure. CTC is proven to cause cancer in animals and is a suspected human carcinogen.

1.2 The Montreal Protocol

To protect the ozone layer, India, along with more than 190 countries has signed the Montreal Protocol to phase out production and consumption of CTC and other ozone depleting substances. Under this agreement India has committed to phase-out the use of CTC as a solvent completely by 31st December 2009.

As the phase-out is progressing, CTC supplies in the market are dwindling rapidly. Beyond 31st December 2009 CTC will not be

available for solvent uses. Given the reduction of supply, the price of CTC has risen substantially making it costlier today than most of its alternatives.

1.3 Role of GTZ-Proklima

For enterprises there is an urgent need to substitute CTC now. But finding suitable alternatives, especially safer ones, is not an easy task. There is no single alternative which can replace CTC in all its applications and in the absence of sufficient information enterprises may substitute CTC with an even more hazardous substance such as Trichloroethylene or Benzene.

Within the framework of the Multilateral Fund of the Montreal Protocol, the Governments of Germany and France have mandated GTZ-Proklima to provide technical assistance to CTC consuming industries in the Indian textiles and metal cleaning sectors. In addition World Bank, UNIDO and UNDP (on behalf of the Government of Japan) are assisting the country in specific industry sectors with large usage of CTC. These activities are coordinated under the National CTC Phase-out Plan by the World Bank as the lead implementing agency and the Ozone Cell of the Ministry of Environment and Forests, Government of India.

GTZ-Proklima offers technical assistance to industries using up to 10 metric tons or 6,250 litres of CTC per year. In close interaction with affected industries, GTZ-Proklima aims to provide competent guidance in identifying CTC substitutes by addressing environmental, health and safety concerns without compromising on quality and cost effectiveness.

GTZ-Proklima maintains strict independence from any branded or proprietary product.

2. CTC in electrical applications

One of the most common uses of CTC that has been identified across the country is in cleaning of electrical applications. Some of these like generators, motors and insulators of high voltage transmission have to be cleaned while they are energized. The major applications are mentioned below:

Switch/Contactors: Electrical contacts develop carbon deposits over time due to the high voltage sparking at the point of contact and disconnection. These deposits reduce conductivity and result in loss of power and therefore contact cleaning is an integral part of preventive maintenance in every industry.

Insulators: The presence of contaminants on high voltage insulators made of ceramics, epoxy and Teflon can cause dielectric breakdown and arcing between otherwise non-conductive surfaces (commonly known as tracking). The result is expensive equipment damage and power outages. Thus periodical cleaning is a requirement in all high voltage applications in power generation units, distribution substations and transmission lines.

Generators/Motors: Oil, grease, dirt, dust, metallic, and chemical contaminants build up over time and reduce or block the required ventilation. If this is allowed to happen, eventually the operating temperature of the motor will rise beyond its maximum rating and damage will occur.

Metallic and chemical contaminants along with abrasive dust and dirt will attack the electrical insulation qualities of the motor/

generator resulting in early failures. Most insulation failures can be blamed on these types of debris collecting in the motor.

For the reasons cited above, motors are cleaned periodically either as regular maintenance or when they are serviced. This application is also specific to large motors in industries and generators in power generation plants.

Transformers: The oil used in the transformers get heated up and burnt during excessive loading and short-circuit conditions. This burnt oil leaves residues on the transformer windings which needs to be cleaned during maintenance.

3. Selecting alternatives to CTC

3.1 Selection criteria

No alternative is ideal in all regards and each one has certain advantages and disadvantages. In order to address environmental, health and safety concerns without compromising on quality and cost effectiveness, any substitute for CTC should meet the following criteria:

- Non-ozone-depleting substance (non-ODS)
- Good cleaning efficacy
- Low toxicity
- High Dielectric strength
- Compatible with insulation material (should not damage)
- Not leaving any residue
- Equal or lower cost compared to CTC
- Locally available
- Non carcinogenic

3.2 Viable alternatives

Based on the selection criteria presented above, GTZ-Proklima identified a range of alternatives for varied applications within the electrical sector. Their suitability has been confirmed through industrial trials. Though Trichloroethylene (TCE) has good cleaning properties and is used by many enterprises, its usage is strongly discouraged because of its inherent cancer risk.

In electrical contact cleaning, one of the main contaminants is carbon deposit. Carbon deposits can be of many kinds – hard coke type, powdery, or sticky bituminous deposits. The suitable alternative has to be selected based on the type of carbon deposit that needs to be removed.

The most relevant properties of available generic solvents for selecting appropriate alternatives to CTC are:

- Flash Point
- Dipole Moment
- Boiling Point
- Hansen Solubility Parameter
- Vapour Pressure
- Dielectric Constant

Flash point

The flash point (in ^{0}C) is the lowest temperature at which a flammable solvent can form an ignitable mixture with air. As a rule of thumb, the higher the flash point temperature the lower is the fire hazard risk. Non-flammable solvents do not have a flash point.

Boiling point

The boiling point (in ^{0}C) is the temperature at which the liquid will start boiling. A lower boiling point means higher losses of solvent into the atmosphere but higher cleaning efficiency.

Dielectric Constant

The dielectric constant of a solvent is a relative measure of its polarity. The lower the dielectric constant of a solvent the better it is for use as electrical contact cleaner.

Vapour pressure

Vapour pressure (in mm Hg) is an indicator for the rate of evaporation under atmospheric conditions. The higher the value the faster the solvent evaporates. If the substance is stored in an open container it can also be considered as a measure of evaporation losses.

Dipole Moment

Dipole moment (in Debye) is a measure of the polarity of a solvent. It determines what type of compounds it can dissolve and with what liquids it is miscible. Typically, polar solvents dissolve polar compounds best and non-polar solvents dissolve non-polar compounds best. Similarly, polar contaminants dissolve best in

polar solvents, while non-polar compounds, like oils or waxes, dissolve best in non-polar solvents.

Hansen Solubility Parameter

The Hansen solubility parameter is a numerical value that indicates the relative solvency behaviour of a specific solvent. It is available for every solvent and any liquid or polymer. This number is calculated from the dispersion, polarity and hydrogen bonding properties of the solvent. It is indicative of the forces that hold together the molecules. It should be noted that solvents with Hansen numbers below 17.5 are more effective in cleaning mineral oils, lubricants and greases.

Table 1
Properties of selected solvents

Parameters	Flash point ^{0}C	Boiling point ^{0}C	Vapour pressure mmHg	Dielectric Constant @ 20 ^{0}C	Hansen solubility parameter
Acetone	–20	56	180	20.56	20.0
Isopropyl alcohol	12	82	33	19.92	23.5
Methylene dichloride*	None	40	350	8.93	20.3
Mineral turpentine oil	36-38	146-197	25	–	15.8
Perchloro ethylene	None	121	14	2.28	20.3
White Petrol	–18	50-120	180	–	7.3

*Only MDC is suggested for online cleaning due to its non-flammability and higher rate of evaporation.

4. Process alternative

4.1 Solvent cleaning

The solvent cleaning is executed mostly by wiping method – a swab or cloth is soaked in solvent and the component to be cleaned is wiped with this swab. This not only results in a very inefficient cleaning and wastage of solvent, but it causes harm to the personnel's health. If solvent use is unavoidable, it is highly recommended to use a hand-operated spray-gun. The advantage is that solvent can be applied directly onto the contaminants, saving on solvent quantity, avoidance of direct skin contact and that of cleaning even inaccessible interior surfaces.

This is most suitable method for cleaning of smaller/low voltage electrical equipment which can be switched off for cleaning. When this is not possible, and the equipment has to be cleaned while it is energised, only MDC can be used as it has very low flammability, high rate of evaporation and low dielectric constant.

There is another very efficient way of cleaning the big generator and motor windings. This is explained in the following section.

4.2 Air pressure and vacuum

Compressed air can also be used to remove dust and light dirt from the exterior and interior of a motor. The air should be dried to remove the moisture content. Compressed air should never be used when metallic dusts such as copper, iron or carbon are present.

During this process wearing of goggles and masks are mandatory as flying particles during cleaning can cause serious injuries.

4.3 Dry blasting

Carbon dioxide (CO_2; dry ice) particle media blasting is a technique that can be used to clean energized power distribution equipment. Contaminants are removed by the impact of the CO_2 particle. The dry ice shears and lifts the contaminant off the surface with no/very

minimal damage and leaves no residual waste. This shearing or lifting force is caused by the sublimation (direct transition from solid phase to gaseous phase) of the dry-ice particles resulting in a sudden 400-fold increase in volume of the gas directed along the plane of the substrate. The contaminant is swept up, or in the case of outdoor switches, blown out of the enclosure. The released CO_2 gas is a naturally occurring atmospheric compound and presents no significant environmental concern.

Operationally, CO_2 pellets have a dielectric constant of 3.1 kV/mm at ambient pressure (about equal to dry air), enabling users to clean energized equipment with no safety hazard. The theory of operation is to generate a large volume of compressed very dry air, transport it to the hot stick/nozzle assembly, mix it with CO_2 pellets in the hot stick, and then direct the mixed stream in a safe manner to the object to be cleaned. The air must be extremely dry because of the tendency for a high voltage arc, often called flashover or tracking or arc blast, to develop along contaminated or wet surfaces. However this process requires special training for the personnel and additional equipment.

5. Health and safety

5.1 Hazard potential of alternatives

Any solvent is a potential hazard for health and safety. Most solvents are toxic but the degree of hazard varies from one substance to another. The hazard of electric shock, when coupled with the effects of solvents could be fatal to the personnel.

At the workplace the intake of chemicals occurs mainly through inhalation and skin contact. Another major risk in the electrical systems is flammability. While these hazards affect directly and immediately the workplace the environmental hazards like contamination of air and ground water are rather indirect effects not only at the workplace but also on a global scale. Thus this guide rates the hazard of each solvent on these four factors.

Each hazard has been further classified into six grades and each grade is characterized through a corresponding colour shade. The least risk is marked in light blue, followed by shades of yellow and orange. Dark red represents the most severe risk.

Table 2
Hazard rating

	Risk	Inhalation	Skin	Environment	Flammability
E	High	Severely toxic	Severely toxic	Very hazardous	Extremely flammable
D		Very toxic	Very toxic		Highly flammable
C		Toxic	Toxic	Hazardous	Flammable
B		Harmful	Harmful		Combustible
A		Irritant	Irritant		Possibly combustible
-	Low	None	None	Not classified	Non-flammable

For details on the hazard classification methodology please visit www.ctc-phaseout.org

Table 3 shows the hazard ratings of the alternatives discussed in the previous section:

Table 3
Hazard rating of specific alternatives

Substance	CAS #	Hazard rating			
		Inhalation	Skin	Environment	Flammability
Acetone	67-64-1	A	A		D
Isopropyl alcohol	67-63-0	A			D
Methylene dichloride	75-09-2	D	C		
Mineral turpentine					D
Perchloro ethylene	127-18-4	D	C	E	
White petrol	Blend	D	C*	E*	D*

*Based on limited current information. To be re-evaluated

The selection of a solvent should be made so as to minimize the hazard. As is apparent from the ratings above, most of the substances are classified as 'Very toxic' for 'Inhalation' and 'Toxic' under 'Skin'. Safe use can therefore not be ensured by a prudent selection alone. The following section introduces measures to safeguard health and safety while using hazardous solvents.

5.2 Risk control measures

This guide recommends the following general principles of prevention:

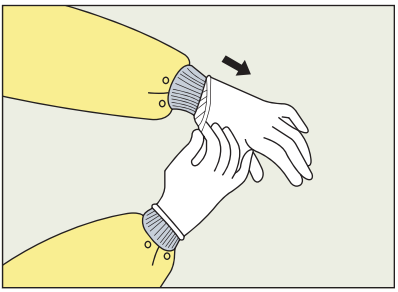
i. Avoid the need for solvent use;
ii. Substitute with less hazardous or non hazardous substances;
iii. Reduce the risks at source using technically up to date methods;
iv. Use measures that give collective protection before considering individual protection;
v. Ensure appropriate instruction and training of all staff concerned;
vi. Provide adequate personal protective equipment (PPE) if a significant risk still remains;

5.3 Good servicing practices

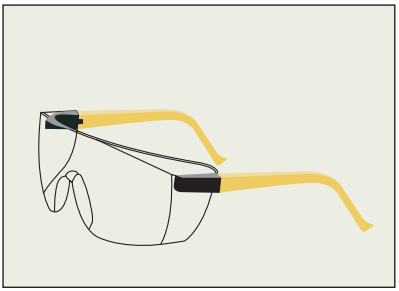
- **Prudent substance selection:** Select the safest possible substance (see table 3 'Hazard ratings of specific alternatives').
- **Consult an MSDS:** Demand a material safety data sheet (MSDS) of the solvent from the retailer. Study specifically the sections on health risks, fire risks and first aid.
- **Limit the quantity:** Often the required quantity for cleaning is overestimated. Therefore assess the required quantity carefully and restrict the use accordingly. It is believed that solvent exposure can be reduced significantly by this measure alone.
- **Purge with inert gases:** Purging with air should be completely avoided as a mix of the solvent with contaminants could prove to be explosive in some cases. Therefore always use only inert gases like CO_2.
- All electrical equipment should be properly grounded & de-energised before carrying out cleaning operation. If online operation is inevitable due to equipment design or operational limitations use only insulated hand tools and solvent with low dielectric constant.
- **Ensure good ventilation:** Many solvents are toxic. While performing the cleaning operation the solvent evaporates into the surroundings. If the cleaning personnel experiences drowsiness or nausea, it is an indication that concentration of solvent vapours is above tolerable limits in the surroundings and there is a need for better ventilation of the cleaning area. The possible options include:
  - Shift cleaning operations to an area with high ceilings and cross-ventilation.
  - If there is a perceivable flow of air, clean downwind so that the air first reaches the cleaning personnel and then the part being cleaned.
  - If none of these prove sufficient, consider the installation of local exhaust ventilation (LEV). LEVs capture contaminants before they disperse into the air of the workplace. Such systems consist of a hood, a duct and an air cleaner.

LEVs cannot be bought off the shelf and they have to be sized by experts to meet the specific requirements.

- **Wear goggles:** Certain cleaning operations may result in splashing of solvents therefore goggles are required for eye protection.
- **Wear gloves:** Skin contact with the solvent during cleaning occurs regularly. All solvents remove the fat content of the skin. Gloves can protect the skin adequately.



Gloves



Goggles

Care should be taken in selecting gloves and other protective clothing as different solvents affect the materials from which they are made in different ways. Some solvents may, for example, pass through some glove materials in a very short time. Table 4 guides the selection of appropriate gloves:

Table 4
Selection of gloves

Chemical handled	Glove Material
Acetone	Butyl, Nitrile, Neoprene, Laminate film
Hexane or White petrol	Nitrile, Neoprene, Viton
Isopropyl alcohol	Nitrile, Neoprene, Butyl, Viton
Methylene dichloride*	Nitrile, for light exposures (splashes), Viton, PVA

*will damage all natural and synthetic glove materials

Face shield

Mask

- **Use respirators:** In any enclosed or confined space such as the inside of a large motor/generator, even a non-toxic solvent may have anaesthetic or asphyxiating effects if it is used in sufficient quantities. Breathing apparatus or respirator may be required to prevent serious injury or even death.
- Always use insulated tools while servicing electrical equipment.
- If the contacts are severely pitted better replace them.
- Ensure moving parts are free from any obstruction to reduce possibility of sparking.
- Deposits like globules on contacts should be removed with blunt knife and use of rough emery cloth should be avoided.
- To avoid sparks apply silicon grease after every cleaning process in high transmission line maintenance.
- Use anti track spray on insulators before rainy season to avoid spark & flash.
- Worker should be trained on hazard and safety precautions.
- While using solvents eliminate open flames and use of lighted matches and cigarettes.
- Make sure fire fighting equipment is always available.
- Use insulated foot and leg protection.
- Use nonconductive flame-resistant head, face, and chin protection (hard hats, full face shields, etc.)

6. Glossary

This glossary defines terms you are likely to encounter in material safety data sheets (MSDS)

Acute effect: The effect caused by a single short term exposure to a high amount of concentration of a substance.

Aerosols: Liquid droplets or solid particles dispersed in air that are of fine enough particle size (0.01 to 100 microns) to remain dispersed for a period of time.

Alkali: Any of a class of substances that liberates hydroxide ions in and have a pH of more than 7. Strong alkalis in solution are corrosive to the skin and mucous membranes. They are also called bases and may cause severe burns.

Anhydrous: Does not contain water (e.g. anhydrous lime)

Asphyxiation: A condition whereby oxygen in the air is replaced by an inert gas such as nitrogen, carbon dioxide, ethane, hydrogen or helium to a level where it cannot sustain life. Normal air contains 21 percent of oxygen. If this concentration falls below about 17 percent, the human body tissue will be deprived of supply of oxygen, causing dizziness, nausea and loss of coordination. This type of situation may occur in confined work places.

Auto-ignition temperature: The minimum temperature at which a material ignites without application or a flame.

Boiling point: The temperature at which liquid changes to a vapour state at a given pressure (usually 760 mm of Hg or one atmosphere).

Caustic: The ability of an alkali to cause burns.

Chronic health effect: An adverse effect on a human body with symptoms developing slowly over a long period of time.

Chronic toxicity: A chronic effect resulting from repeated doses of or exposure to a substance over a relatively prolonged period of time.

Confined space: Any area that has limited openings for entry or exit that would make escape difficult in an emergency, has a lack of ventilation, contains known and potential hazard, and is not normally intended or designed for continuous human occupancy (e.g. a storage tank, manhole of collection conveyances systems in effluent treatment plants).

Dielectric constant: The dielectric constant of a solvent is a relative measure of its polarity.

Explosion proof-equipment: Apparatus or device enclosed in a case capable of withstanding an explosion of specified gas or vapour and preventing the ignition of specified gas or vapour surrounding the enclosure by sparks, flash or explosion and operating at an external temperature so that surrounding flammable atmosphere will not be ignited.

Flammable: A flammable liquid is defined as a liquid with a flash point between 21 and 55 degrees Celsius. It may catch fire on contact with a source of ignition.

Flammable/explosion limits: Flammable/explosion limits produce a minimum and a maximum concentration of gases/vapours/fumes in air that will support combustion. The lowest concentration is known as the lower flammable/explosion limit (LEL), the highest concentration is known as upper flammable/explosion limit (UFL).

Flash point: Minimum temperature at which, under specific conditions, a liquid gives off sufficient flammable gas/vapour to produce a flash on contact with a source of ignition.

General exhaust/ventilation: A system for exhausting or replacing air containing contaminants from a general work area.

Hansen Solubility Parameter: A numerical value that indicates the relative solvency behaviour of a specific solvent. This number is calculated (based on volume percentage) from the properties dispersion, polarity and hydrogen bonding of the solvent. Hansen solubility parameter is available for every solvent, any liquid or polymer.

Hazard: A potential to cause danger to life, health, property or the environment.

IDLH (Immediate danger to life and health): The maximum concentration from which one could escape with in 30 minutes without any escape-impairing symptoms or irreversible health effects. Usually used to describe a condition where self contained breathing apparatus (SCBA) must be used

Incompatible: Condition of materials that could cause dangerous reactions from direct contact with one another. Particularly relevant when storing different substances in the same place.

Local exhaust: A system or device for capturing and exhausting contaminants from the air at the point where the contaminants are produced. (e.g. dust in shaving and buffing)

MSDS (Material safety data sheet): Consolidated information on specific identity of hazardous chemical substances, also including information on health effects, first medical aid, chemical and physical properties, emergency measures etc.

OEL (Occupational exposure limit): An exposure level established by a regulatory authority (e.g. OSHA, NIOSH).

Poisoning: Normally the human body is able to cope with a variety of substances within certain limits. Poisoning occurs when these limits are exceeded and the body is unable to deal with a substance (by digestion, absorption or excretion)

Risk: The measured probability of an event to cause danger to life, health, property or the environment.

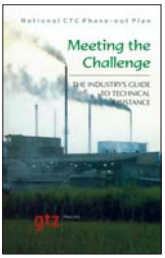
TLV (Threshold limit value): A concentration threshold in the atmosphere which is set specially for each pollutant. It refers to the limit accepted in the atmosphere of working area.

TLV-STEL (TLV short term exposure limit): Concentration threshold in an atmosphere contaminated with a specific type of pollutant for a 15 minute exposure (if not otherwise specified)

TLV-TWA (TLV time weighted average): Concentration threshold in an atmosphere contaminated with a specific type of pollutant, usually for a continuous eight hour exposure

Toxicity: The inherent potential of a chemical substance to cause poisoning.

7. Other publications for you



Meeting the Challenge provides essential information on CTC Phase out and industry sectors most affected by it. The publication also elaborates on 'applications' across sectors affected by CTC phase out as also GTZ-Proklima's mandate, approach and technical assistance provided to affected industries.

Languages: English, Hindi, Gujarati, Kannada and Malayalam

Solvent Alternatives is a compilation of technical information on a variety of CTC alternatives that are in use in industry – across industry sectors and applications. The advisory elaborates on use and potential risks involved therein, with regard to profiled substances

Languages: English

Industry specific guidelines for the substitution of CTC in about 10 sectors are under preparation. Their launch is expected from December 2008. Similar to this guideline for RAC enterprises, other guidelines will inform of alternatives to CTC in other sectors and their safe use.

Languages: English

All publications are also available for free download at our website www.ctc-phaseout.org

Notes

Ozone Cell, Ministry of Environment and Forests, Government of India, is the central agency coordinating the phase-out of CTC. The cell has established the regulatory framework and national phase-out plan. It ensures that domestic CTC production and import progressively decrease in compliance with national targets.

The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH is an international cooperation enterprise for sustainable development with worldwide operations. GTZ-Proklima is a sectoral program which implements bilateral and multilateral projects in order to assist partner countries in fulfilling their obligations under the Montreal Protocol. With more than 130 projects, GTZ-Proklima is the largest bilateral partner of the Multilateral Fund of the Montreal Protocol. GTZ-Proklima, on behalf of the Government of Germany and under the overall coordination of Ozone Cell, Ministry of Environment and Forests, provides support to Indian industries for smooth transition to a CTC-free world. In the current project GTZ-Proklima holds an additional mandate on behalf of the Government of France which provides financial support through its French Global Environment Facility (FFEM). GTZ-Proklima does not promote any particular product or brand but provides technical assistance to CTC consuming industries.

National CTC Phase-out Plan

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Annexure-E

Statement of CTC Usage in Power Utilities based on the questionnaire circulated.

SNo	Name of the Organization & Address	Field of operation	Qty of CTC used	Alternative to CTC	Name & Address of the manufacturer of Alternative	Qty used	Efficacy of alternative Excellent/Good/Fair	Any Effect on Worker
1	Guru Hargobind T P S, PSEB,Lehra Mohabbat,Distt. Bhatinda (Punjab)-151111	Generation	3.6 litres from M/s Qualigens Fine Chemicals, Dr. Anni Besant Road, Mumbai-40025	Nil				Nil
2	Karnataka Power Transmission Corp. Ltd, Office of the Chief Engineer, Electricity, Research & Development Centre, '	Transmission		i) 2-Propanol GR ii) Rust hick 631	i) Merck Specialties Private Limited, Shivsagar Estate 'A' Dr. Anne Besant Road, Worli Mumbai-400018 ii) ITW India Ltd., Plot No. 34-37, Phase 2, IDA, APLIC, Pashmmylaram, Medak District-502307, A.P	2 litres	Good	Headache
3	PRAGATI POWER STATION, Pragati Power Corporation Ltd, I.P State, Ring Road, New Delhi-02	Generation		i)STANVAC(# 8070 ELECTRICAL 88 CO2, # 8480 CARBON CLEANER) ii) Kard Kleen,	i)STANVACCHEMICAL (INDIA), H.O:-LGF 18-19, D-15 NDSE-II, N. Delhi-49 ii) MOLT-GRPH, Anand Engineering Pvt Ltd.,	i) Approx.24 Nos. bottles of 700ml each ii) 10-12 Nos	Good	Non

SNo	Name of the Organization & Address	Field of operation	Qty of CTC used	Alternative to CTC	Name & Address of the manufacturer of Alternative	Qty used	Efficacy of alternative Excellent/Good/Fair	Any Effect on Worker
					66, MIDC Road No.13, Andheri (E), Mumbai-400093.			
4	GUJARAT ENERGY TRANSMISSION CORPORATION LTD, OFFICE OF THE CHIEF (TRANASMISSION), Sardar Patel Vidyut Bhawan, Race Course, Vadodara-390007	Transmission		1)Zorilclc 88, 2) UKS 2621	1) Pidilite industries Ltd.Regent Chambers, 7th Floor, Jamanalal Bajaj Marg, 208, Nariman Point, Mumbai-400021. 2) 5/9, Tine Rose Road, Banglore-560025	1) 22 Ltrs. 2) 22Ltrs.	Good	Non
5	Karnataka Power Corporation Ltd., 82, Shakti Bhawan, Race Course Road, Banglore-560001	Generation		1) OKS 2621, klinit for contact cleaning. 2) Lectra Clean, Acetone, Petrol for other works				Non
6	Hasdeo Thermal Power Station, Korba West Chhattisgarh State Power Generation Co. Ltd.	Generation		1) KLI - NIT CT-2 (2) MOLYKOTE S - 1002 (3) CRC 2 - 26	(1)Kappa sigma corporation 104, shiv industrial estate parel cross lane Mumbai 400012 (2) Dowcorning corporation, MidLand - Michigan U.S.A, Imported by Dow corning India Pvt.Ltd.,Wockhard Towers, Eastwing ,Level 2, Bandra kurla complex, Bandra East, Mumbai 400051	(1) 980 litres (2)120 litres (3) 45millilitre	Good	Non

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					(3) CRC Industries Europe A/ distributer, M/s saikripa Enterprises, 2,3 Farishta Complex Station Road Durg			
7	Brahampuram Diesel Power Plant, KSE Board,Brahampuram P.O, Kochi- 682303	Generation	2.5 litres - Contact Cleaning					
8	Office of the Executive Director(o & m-Gen), M.P.Generating Co. Ltd., Block No.6, shakti Bhawan, Rampur, Jabalpur-482008(MP), (1) STPS Sarni (2) SGTPS, Brisinghpur (3) ATPS, Chachai	(1) Analysis in Chemical Lab (2) Cleaning of Relay Contracts and Ele. Current Carrying Parts (3) Not in use	(1) 4 litres (2) 25 litres. (3) Nil	(1) selco electroclean, crc-2-26 & wd 40 (for electrical section) (2) a acetone b. Stanvak contact cleaner c petrol (3) isopropyl alcohol electrical contact cleaner 4)Petrol			(1) Effective (2) Good (3) Good	
9	Torrent Power Ltd. (Ahmedabad Operations) Electricity House, Lal Darwaja, Ahmedabad-380001	1) Generation:- For testing work at our combine cycle power plant laboratory. 2)Distribution :- For cleaning of metal contacts of electrical equipments		1) Benzene/Toulene 2) Super Electro Safe Z-136				
10	Utran Gas based power station, Gujarat State	Generation		Methanol	Ranbaxy Laboratory A-3, Okhla Industrial	3 to 5 litres	Good	

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	Electricity Corporation Ltd., Utran - 394105, Surat City				Area, Phase-I, New Delhi			
11	Wanakbori Thermal Power Station, Gujarat State Electricity Corp. Ltd., Taluka thasra, district Kheda, Gujarat -388239	Generation		OKS 2621 T contact cleaner	OKS specialty lubricants (I) (p) Ltd., Silver Jubilee Block, 3rd Floor, Unity Building Mission Road, 3rd cross, Bangalore-27	5 Bottle of 500 ML	Excellent	Nil
12	Ukai Thermal Power Station, Gujarat State Electricity Corp. Ltd., Ukai Dam-394680, Dist. Tapi	Generation		Crown Electronic component cleaner (spray)	Stanvac Chemicals (India) Ltd. H.O. LGF 18-19, D-15, NDSE-111, New Delhi-49	Approx. 616 L	Good	No
13	Sikka Thermal Power Station,Gujarat State Electricity Corp. Ltd. Po;-Sikka, Dist. Jamnagar, Gujrat	Generation		i)Molykote, ii) Stanvac			Good	
14	Dhuvaran Thermal Power Station, Distt. Anand (Gujarat) - 388 610	Generation		1)Zorrik 88 Spray 2) OKS 2621/2 Spray	1)ACCRA PAC India Pvt. Ltd. , Plot - 1105, Phase III G.I.D.C. Vapi, Gujarat - 396 195 Regent Chambers, Mumbai 2) Kluber Lubrication India Pvt. Ltd, 347-A, Herbbal Industrial Area, P.O. Metagalli, Mysore -	1) 2400 gram 2) 1100 gram	Excellent	None
15	Barauni Therma Power station, Begusarai, Bihar	Generation	Nil					
16	Orissa Power Generation	Genreation	Nil	CRC-2-26, Make-CRC				

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	Corp. Ltd. PO. Banaharpali, Distt. Jharsuguda, Orissa-							
17	JSW Energy,(Torangallu),PB No. 9, Torangallu, District Bellary, Karnatka	Generation	Nil	i) CFC free cleaner, ii) Dyes, iii) Diesel			Good	
18	Genral Manager/Electrical, Thermal Power Satation II, NLC Ltd. Neyveli-607807, Tamil Nadu	Generation	Nil	i) i) WD-40, ii) Petrol, iii) Diesel, iv) Kerosene, v) CRC 2-26			O.K	
19	Maharastra State Power Gen. Co. LTD. i) Koradi TPS	Generation	Nil					
20	Maharastra State Power Gen. Co. LTD., Nasik TPS	Generation	Nil	i) Acetone ii) Petrol				
21	Maharastra State Power Gen. Co. LTD., Bhusawal TPS	Generation	Nil	i) Acetone				
22	Maharastra State Power Gen. Co. LTD.,Khaparkheda TPS	Generation	Nil	i) Klinit ii) OKS2621				
23	Maharastra State Power Gen. Co. LTD.,Chandrapura TPS	Generation	Nil	i) Klinit ii) WD-40				
24	Maharastra State Power Gen. Co. LTD.,Parli TPS	Generation	Nil	i) Klinit ii) Wonder XTETHFRA				
25	Maharastra State Power Gen. Co. LTD., Pophali	Generation	Nil	i) Klintek (Spray)				
26	GGSSTP,PSEB, Roopnagar-140113, Punjab	Generation	Nil	i) CRC(brand name) for contact cleaner			Satisfactory	

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				ii) Petrol				
27	URI Power St.,NHPC Office Complex, Sector-33, Faridabad-121003(Haryana)	Generation	20 Litre	i) CRC-2 Isopropyl Alcohol, Safety Solvent			Very Good	
28	Tehri HPP,(Hydro Power Plant)	Generation	Nil	i) Acetone			Very Good	
29	Indraprastha Power Gen. Co.Ltd. ' HIMADARI' Rajghat Power House, New Delhi-02	Generation	Nil	i) CRC ii) DC2-26	M/s. Danmet Chemical Pvt. Ltd. Unit No. 3 Industrial Estate, Centiry Bazar Lane, Prabhdevi, Mumbai-400025		Good	

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30	Neyveli Lignite Corp. Ltd., Corporate Environment Cell, CTO Building, Block-1, Neyveli-607801	Generation	Nil	1.Wurth Sabersto Spray 2.OKS 2621T Spray 3. Moly-Graph Easy Clean Spray 4. CRC-26 Spray 5.OKS 601 Spray 6. WD 40 Spray 7. CRC, Molykote, WD 40	1. Wurth U.K. Ltd., 1 Centurian way, Erith, Kant D4184 AE 2. OKS Specialty Lubricants (India) Pvt. Ltd. 5/9 Primrose Road, Bangalore-560 025 3. Anand Engineers Pvt. Ltd. 66, MIDC Road, No.13 Andheri (E), Mumbai 4. Danmet Chemicals Pvt. Ltd. 9, Bussa Industrial Estate, Prabhadevi Mumbai-25 Marketed by Bharat Bijilee Ltd. 5. Kluber Lubrication India Pvt. Ltd. 347-A, Hebbal Industrial Area, P.O. Metagalli, Mysore - 570016 6. Made in USA Imported & Marketed by Hard Cashe & Woud manufacturing Co. Ltd. Hetivalibang, Kalyan-421306	1. 24 nos.(400 ml each) 2. 24 nos. (500 ml each) 3. 25 ltrs for P&C Dvn. (UCB-CHB,ESP,SEE AC mtce dvn) 4. 100 cans/annum (approx.) 5. 250 ltrs. 6. 250 ltrs. 7. 120 ltrs.	1. Satisfactory 2. Satisfactory 3. Good 4. Good 5 Good 6. Good 7. Good	1. Vapors may cause drowsiness and dizziness. Do not breath gas or spray. Avoid contact with skin. Repeated exposure may cause skin dryness or cracking. 2. Use only in well-ventilated area. 3. Nil. 4. no effect on worker. 5. No. 6. No. 7. No.