Green Gray

ENVIS NEWSLETTER

CENTRE FOR ENVIRONMENTAL STUDIES
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(Forest & Environment Department, Government of Orissa)

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State of the Environment, Orissa : Flyash Management

Nearly 73% of the country's total installed power generation capacity is thermal of which coal-based generation is 90%. Some 85 thermal power stations, besides several captive power plants use bituminous and sub-bituminous coal and produce large quantities of fly ash. High ash content (30% - 50%) coal contributes to these large volumes of fly ash. The country's dependence on coal for power generation has unchanged.

Thus fly ash management is a cause of concern for the future.

FLY ASH – Problem & Management Aspects

The World Bank has cautioned India that by 2015, disposal of coal ash would require 1000 sq. km. of land. Since coal currently accounts for 70% of power production in the country, there is a need of new and innovative methods for reducing impacts on the environment.

The problem with fly ash lies in the fact that not only does its disposal require large quantities of land, water and energy, its fine particles, if not managed well, can become airborne. Currently 90 million tones of fly ash is being generated annually in India, with 65000 acres of land being occupied by ash ponds. Such a huge quantity dose pose challenging problems, in the form of land use, health hazards and environmental damages. Fly ash is also a raw material for different industries. Some of major application areas of fly ash are: Cement manufacturing, part replacement of cement in mortar and concrete, road & embankment construction, dyke raising, structural fill for reclaiming low lying areas, hydraulic structures, stowing material for mines, agricultural & forestry and other medium & high value added products like tiles, paints, light weight aggregate, extraction of alumina, cenospheres, bricks etc.

Fly ash as a material is siliceous or aluminous with pozzolanic properties. It is refractory and alkaline in nature, having fineness in the range of 3000-6000 sq. km / gm. Silica, metal and has metal oxides, sulphur are the main constituents of fly ash (See Table –I).

Table-I

Constituent	Percentage Range (%)
Silica (SiO_2)	49-67
Alumina (Al_2O_3)	16-29
Iron Oxide (Fe_2O_3)	4-10
Calcium Oxide (CaO)	1-4
Magnesium Oxide (MgO)	0.2-2
Sulphur (SO_3)	0.1-2
Loss of Ignition	0.5-3

Hazards:

By virtue of its physical characteristics and sheer volumes generated, fly ash poses problems like:

- It is a very difficult material to handle in dry state because it is very fine and readily airborne even in mild wind.
- It disturbs the ecology of the region, being a source of soil, air and water pollution.
- Long inhalation of fly ash causes silicosis, fibrosis of lungs, bronchitis, pneumonitis etc.
- Flying fine particles of ash poses problems for people living near power stations, corrode structural surfaces and affect horticulture.
- Eventual settlement of fly ash particles over many hectares of land in the vicinity of power station brings about perceptible degeneration in soil characteristics.

Presently about 100 million tonnes of fly ash is generated from thermal power units in India. It is estimated that by the end of the tenth plan period (March 2007) an additional 124000 MW of power sector expansion will be required in India to meet the rising energy demand. Though the state of Orissa is not thickly industrialized, the fly ash generation in the state is to the tune of 93 lakh tones per annum (Table II). With 40 odd MOU is designed for further industrial development the quantum of fly ash generation will increase in the future.

Table-II

Utilisation of Fly ash in Thermal Power Plants of Orissa during 2004-05:

Name of the Plant	Quantity ash generated Million (Tonne)	Disposal method	Brick making (Tonne)	Supplied to Industry Other Agency (Tonne)	Land filling (Tonne)	Embankment Dyke raising (Tonne)	Other Purposes (Tonne)
NALCO, AngulCPP,	2.14	Wet disposal Ash pond	1200	67459	-	47580	400 in Agriculture
IB Thermal Power	0.876	Wet disposal Ash pond	617	67260	935	80102	
Indian Aluminium Company Ltd.,Hirakud	0.189	Dry ash disposal	7562	2491 (Cement Industries)	123855	-	55299 ash Mound
ICCL, Cuttack	0.31	By dumpers (Dry disposal)	Nil	Nil	-	Nil	310332 (Reclamation on waste and degraded land)
NTPC,Angul	4.62	Wet disposal ash pond	28735	19054	733059	207613	12991 ash based products
Talcher Thermal Power Station, Angul	0.977	Abandoned Mine pit	5476	55863	-	78000	5275 ash based products 59059 mine backfilling
Rourkela Steel Plant (CPP-I)	0.21	Wet disposal	Wet disposal	-	8400	-	-

As far as thermal power sectors in Orissa is concerned about 22.6% of fly ash is being utilized. This trend in future may require large amount of land area for disposal of fly ash. Some Industries have made their own targets to utilize 100% ash in future.

Current Fly Ash Disposal Practices and Effects:

At thermal power plants, fly ash is generally collected / disposed off by using wet or dry systems. In cases where fly ash collection systems are not very efficient, a portion of it escapes into the atmosphere causing environmental pollution. In the wet system, fly ash is mixed with water & sluiced to settling ponds or dumping areas near the plant. Being cheaper than any other manner of fly ash removal, it is the widely used method in India.

Electrostatic precipitation is the most popular and widely used method of emission control today, which enables collection of dry fly ash. After arresting the fly ash in ESP, it is than transported to silos through suction or by pressurized air. When required, this can be obtained in the container for further transportation directly from the silos through chutes at the bottom or to the delivery point by pipeline using vacuum suction or pressurized air.

Fly ash utilization in India:

No single utilization held the potential to provide a solution to the mammoth task of safe disposal and gainful utilization of fly ash. A number of applications is required to be simultaneously demonstrated to increase the percentage utilization and environmentally safe practices of fly ash disposal. Today fly ash utilization has increased 13% of the total generation. There is greater acceptance of fly ash products & applications.

(a) Fly Ash Bricks

Institutes like IITS and TERI, Government agencies like CPWD, HUDCO and some of private agencies have accepted to use of fly ash bricks in construction. Institutional acceptance of fly ash bricks as a result of confidence building activities of fly ash mission has triggered the acceptance of fly ash bricks by more and more user agencies.

(b) Fly Ash Cement / Fly Ash as a part replacement of cement:

Use of fly ash as a part replacement of cement in mortar and concrete is being increased. Manufacture and use of fly ash cellular concrete has started at chennai. Cement Manufacture's association (CMA) and association of Ready Mix Concrete (RMC) have shown interest to work along with Fly Ash Mission to enhance the use of fly ash in cement and RMC.

(c) Roads & Embankments:

Use of fly ash in the construction of roads and embankments has been successfully demonstrated in the country. The Ministry of Surface Transport and CPWD have in principle accepted the use of fly ash and have cleared / executed few projects.

(d) Ash Pond Dykes:

Use of fly ash for construction of fly ash pond dykes has started getting wider acceptance. More ash dykes are being constructed with fly ash resulting in reduced demand of land for fly ash disposal.

(e) Structural Fill / Reclamation of low lying areas:

Use of fly ash as a structural fill material for reclaiming low-lying areas has also started getting acceptance by the users.

(f) Stowing Material for Mine fill:

Use of fly ash as a mine fill material has been demonstrated by NTPC & MoEF at two sites. It has become one of the possible alternatives to be considered by various agencies.

(g) Mine pit disposal of fly ash in Orissa:

A feasibility study for ash disposal in abandoned mine pit was conducted by Central Mine Planning and Designing Institute (CMPDI) followed by hydrological investigation and environmental impact assessment study for disposal of ash in South Balanda Open Cast Project of Orissa. The study indicated that the ash disposal in the mine voids of South Balanda is not likely to pose any significant environmental risk. On the basis of the study, M/s TTPS (NTPC) allowed to discharge their ash slurry into the mine voids of South Balanda. The State Pollution Control Board coordinated with MCL and the power generating units of the state agreed to handover the abandoned mine pit for ash disposal. In this way MCL offered the abandoned pit of Bharatpur Open Cast Project for disposal ash of NALCO (CPP) and South Balanda for disposal of ash generated from Talcher Thermal Power Station. Currently TTPS is carrying fly ash slurry through a pipeline of about 9 km. to the abandoned mine pit.

Leachability study of fly ash- It is a common fear of leachability of trace metals into the underground water due to disposal of fly ash in the abandoned mine pits. To determine the mobility of trace metals from fly ash central Mine Planning & Design Institute, Ranchi has conducted a survey in Orissa this regard. They concluded that the leaching of trace metals from coal ash will not pollute the underground / surface water sources as all toxic elements are present in concentration less than the limits prescribed by Bureau of Indian Standards.

(h) Agricultural Application:

Use of fly ash in agricultural applications has been well demonstrated and has been accepted by a large number of farmers. This use is picking up in Karnataka, Tamilnadu, West Bengal and Madhya Pradesh and for wasteland reclamation in Uttar Pradesh.

Government level Initiatives for fly ash utilization:

Apart from the technological research and development effected by TPPs, academic and R&D institutions, various departments and Ministries of the Government of India have taken initiatives in the area of fly ash utilization. Some of the main initiatives are:

- Ministry of Environment & Forest, Govt. of India has brought out a Gazette Notification for restricting the use of fly ash in building materials and construction activity. The notification makes it mandatory to use at least 25% ash (fly ash, bottom ash or pond ash) in manufacture of clay bricks, blocks or tiles within a radius of 50 km from coal or lignite based thermal power plants. As per the notification every thermal power plant has to make ash available without any payment for the purpose of manufacturing ash based products such as cements, brick, blocks, roads, embankment etc. at least for ten years. All coal-based power plants have to evolve an action plan utilization of ash produced.
- The PWDs, local development and housing authorities as well as National Highway Authority of India are directed to prescribe use of ash & ash based products in their respective schedules of specifications and codes of practices etc.
- To encourage production and use of fly ash based products Govt. of India has withdrawn 8% excise duty imposed earlier on such products. Now, no excise duty shall be levied on manufacture of goods in which a minimum of 25% fly ash is used. Similarly for import of capital goods (machinery, equipment etc.) of certain kind used for manufacture of fly ash products, additional custom duty has been exempted.
- State Governments of Orissa, Rajasthan, Andhra Pradesh, Tamil Nadu, Punjab have announced various schemes / measures to promote fly ash utilization. Govt. of Orissa has exempted fly ash brick and other products from sales tax. A separate cell to promote fly ash has been created in few states.
- The National Housing policy (1998) by the Ministry of Urban Development and subsequent draft policy documents lay stress on promotion of low cost building materials which include fly ash. Building materials and Technology promotion Council (BMTPC) in 1990, under the aegis of Ministry of Urban development as an inter ministerial apex organization has been involved in coordinating with various PWD schedules, preparation of technology profiles for various fly ash based products, providing inputs towards technology scanning, fixing of land rent, policy review etc.
- A centrally sponsored scheme called National Network of Building centers was launched in 1988-89 through HUDCO.
- HUDCO and NHB are extending financial support to promote industrial units for production of building materials based on fly ash.
- A fly ash mission has been constituted with department of Science and Technology (TIFAC) as the nodal agency and in coordination with Ministry of Environment & Forests and Ministry of Power. Annual National Award for fly ash has been given to the thermal power plants, fly ash based products manufactures, end users of fly ash / its products, R & D and facilitators.
- Indian Road Congress (IRC) have issued Guidelines (SP- 58) for use of ash as fill material in Road Embankments (March 2001)
- Indian Road Congress (IRC) has published "Rural Roads Manual" wherein various methods of utilization of ash in roads and embankment construction are covered. (Feb. 2002)

- As per Bureau of Indian Standards (BIS) fly ash up to 35% by weight can be used in manufacture of Portland Pozzolana Cement (PPC).
- IS 456-2000: Code of practice for plain and reinforced concrete allows use of fly ash (up to 35 %) as a cementations content in concrete (where OPC is used).

Success Stories on Fly Ash Utilization

1. Embankments of fly over bridges in Delhi, roads at Raichur, Delhi, Kolkata, Dadri, Ramagundam and Vishakhapatnam have been constructed using fly ash.
2. The construction of first dam in India using Roller Compacted Concrete (RCC) technology with high doses of fly ash has been started near Nasik under Ghatghar pumped storage scheme of Irrigation Department, Govt. of Maharashtra. Approximately 60-70% cement is being replaced by fly ash. Three dams would be constructed under this project using RCC technology with high doses of fly ash, which includes a major dam of height about 90 m.
3. Supported by CRRI and the fly ash mission, PWD, Delhi took up the use of fly ash for construction of the Nijamuddin Bridge embankment, Delhi Vidyut Board (DVB) agreed to supply 1-5 lakh m^3 of pond ash for the project. It is estimated that there is a direct cost saving of around 30-40% in road embankments of fly ash is used instead of soil.
4. A dyke constructed with fly ash at Kobra Thermal power Station.
5. For the first time in India use of pond ash in under ground mine stowing in working panel has been successfully demonstrated. Approximately 10000 Cum pond ash has been stowed in the under ground mine PK-I of Singereni Collieries Company Ltd. (SCCL), Manuguru area from a captive Thermal Power Station of Heavy Water Plant (Department of Atomic Energy) at Manuguru, Andhra Pradesh. The project has been implemented by Central Mining and Research Institute, Dhanbad. Similar project is also going on at Western Coalfield Ltd. (WCL), Chandrapur.
6. Fly ash has been used for landfill and Embankment Construction in Delhi metro.
7. Fly ash use in road works.

Sl. No	Name of the Project	Total quantity of fly ash proposed to be used
(i)	Km 8-2 to km 29.3 of NH-1in Delhi	100000 Cum
(ii)	Haldia port connectivity project-4 laming of NH-41 from km 0 to km 52.7	1180000 Cum
(iii)	Km 470 to km 483-33 & km 0 to km 380of NH-2 in U.P.	335000 Cum
(iv)	4/6 laming of NH-6 in WB from km 17.6 to km 72	3234623 Cum
(v)	4/6 laming of NH-6 in WB from km 72. 0 to km 132.45	321300 Cum
(vi)	Dungapur Expressway	900000 Cum
(vii)	Allahabad Bypass on NH-2	6732000 Cum

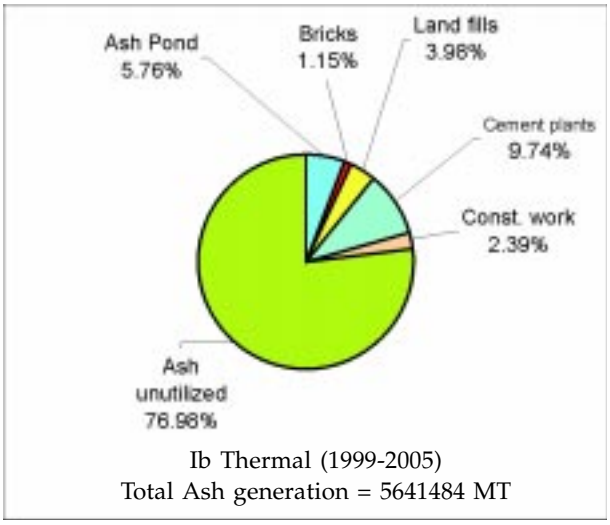
8. Experiments were conducted with fly ash from TTPS, Talcher, Orissa to determine its applicability for soil amendment, wasteland management and agricultural crops. The experiment was conducted by Khallikote College, Berhampur with the help of the earst while Orissa Environment programme (OEP) under IndoNorwegian Cooperation (NORAD).
9. Fly ash is also utilized for manufacture of construction materials like light weight aggregates, alumina and cement clinkers. A research on this was conducted by Regional Research Laboratory (RRL), Bhubaneswar, Orissa under OEP.
10. Promotional incentive for fly ash bricks was initiated by Orissa Renewable Energy Development Agency (OREDA), Bhubaneswar, under OEP. In order to generate awareness among the public for use of fly ash bricks, a number of promotional activities were being undertaken. Further, under NORAD'S assistance, sales linked incentive up to Rs. 30/- for every 100 fly ash bricks sold was given to entrepreneur during first phase of setting up fly ash brick unit.

11. As many as fifty small-scale fly ash brick industries have come up in Orissa under fly ash utilization programme under OEP.

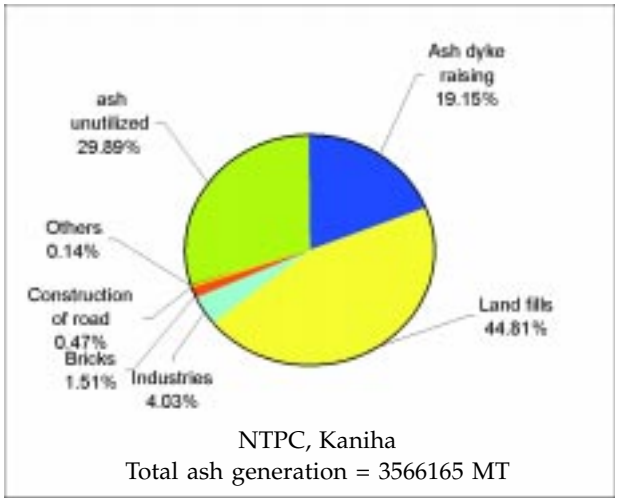
12. Central Fuel Research Institute, Dhanbad has implemented a project on huge application of fly ash in afforestation work in the waste land & vacant land of Mahanadi Coalfield Ltd. at Talcher and Ib valley area in Orissa.

Fly ash utilization in Orissa

TTPS, Talcher (1999-2005)
Total ash generation = 5181000 tonnes



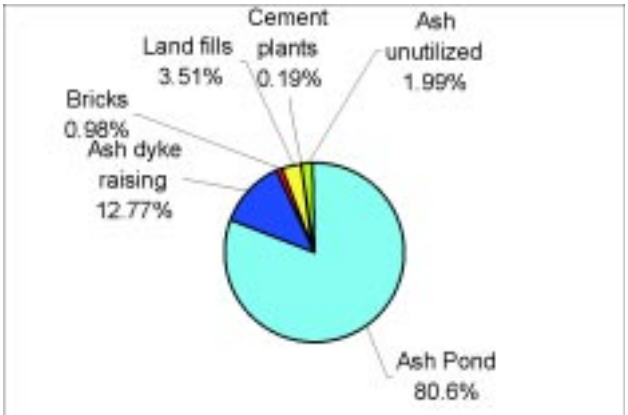
Ib Thermal (1999-2005)
Total Ash generation = 5641484 MT



NTPC, Kaniha
Total ash generation = 3566165 MT

The common scenario of ash utilization in power plants of Orissa like National Thermal Power Corporation, Talcher Thermal Power Station and CPP, NALCO are as a feed material to cement plants, brick making, wet disposal in ash ponds, filling of low laying areas, road construction and ash dyke raising. Besides ash pond, major part of ash is being used in ash dyke raising and land fills by TTPS and NTPC. Whereas in Ib thermal more importance has been given in supplying ash to cement plants. The percent utilization of fly ash in Orissa is shown in picture-1.

Though ash utilization in mine void filling has not been adopted by the thermal power plants in Orissa, TTPS has started disposal of ash in Jagannath mine of MCL on trial basis. However optimum utilization ash through mine void filling by High Concentration Slurry Disposal (HCSD) System may prove a plausible solution to the fly ash management in the state. (See box for advantages of HCSD)



TTPS, Talcher (1999-2005)
Total ash generation = 5181000 Tonnes

Advantages of HCSD

- Transfers high concentrated ash slurry.
- Ensures dry disposal.
- Requires less disposal space due to dry stacking & high-density deposit.
- Does not require a large ash dyke.
- No water pollution & no dusting – because of solidification of Slurry at disposal site.
- Easy drainage of rainwater.
- No pollution during transportation because of fully enclosed pipeline system.
- Minimizes risk on environment, as chance of percolation of water is minimum.

What some dailies report: -

1. A small-scale industry named membrane filters (India) Pvt. Ltd. near Pune is turning out a range of water filters based on indigenously developed technology that has won national and international patents for the elimination of both bacteria and viruses-without needing any power source. The technology has been developed at the Council of Scientific and Industrial Research (CSIR) Pune based National Chemical Laboratory (NCL). The filters are capable to remove Hepatitis A, water borne bacteria and E coli.

   Source- The Hindu, 28th November 2005.

2. Environment beyond tress and tigers, a two day film festival has been organized by New Delhi based Centre for Science and Environment (CSE) in collaboration with Sambalpur, Orissa based NGO, Manav Adhikar, Seva Samiti, Orissa. Some of the finest documentaries from across the world on some of today's most relevant and pressing environmental issues have been screened to create awareness among people, especially among the school and college students on issues like climate change and global warming, urban water scenario and rainwater harvesting along with wild life protection and eco-sanitation.

   Source- The New Indian Express, 30th November 2005

3. The biodiversity in Satkoshia Biosphere located in Angul, Orissa is going to be extinct. Mining Industrialisation and Urbanisation is now creating a question mark on the stability of this biosphere.

   Source- The Sambad, 2nd December 2005

4. Chinese Power Giant to Sell Carbon Dioxide to Spain under CDM Contract

The Chinese electric utility Huaneng and the Spanish National Power Corporation Endesa have unveiled a pioneering initiative for purchasing emissions credits generated under the

Kyoto Protocol's Clean Development Mechanism (CDM), according to the 21 st Century Business Herald. The deal, announced January 19 in Beijing, is the first in China's power sector to be put into implementation. This initiative will generate roughly 3 billion RMB (US $375 million) for Huaneng and benefit the utility's fledging wind power projects.

Under the carbon credit-purchasing contract, Endesa will buy 2.6 million tons of carbon dioxide (CO_2) generated by three wind energy farms operated by Huaneng. The wind farms have a total capacity of 195 megawatts. The deal is a ten-year fixed term with a negotiated price of $8.70 per ton, compared with a European market price of around 20 Euro per ton (approximately $25).

Source- China Watch – Jan-23-2006

5. Coal: Dirty from Start to Finish

Extracting coal from the Earth for energy is a treacherous proposition. The recent Sago Mine disaster that left 12 miners dead in Tallmansville, West Virginia, brought to light the very real dangers faced by thousands of coal miners in the United States every day. In the developing world, however, disasters such as these are far more common and more deadly. In China alone, nearly 2,700 coal miners lost their lives in just the first half of 2005.

Once coal is extracted, its combustion releases a plume of toxic substances into the air. One of the worst is mercury, potent neurotoxin with globetrotting capabilities. Tiny amounts of mercury can cause severe illness, including brain damage, especially in young children. Mercury emissions have found their way to the ends of the Earth, poisoning wildlife and indigenous peoples as far north as the Artic Circle. Coal combustion is responsible for as much as two thirds of the 2000+ tons of yearly human mercury emissions.

Source-World Watch Institute

6. China and India Hold World in Balance

Recent commitments by both China & India to develop large wind power and solar energy industries are likely to make a host of new technologies affordable for poor countries. Their early successful efforts to employ new approaches include:

- In 2005, both nations committed to accelerating the development of new energy sources. India will seek to increase renewable energy's share of its power from 5 percent to 20-25 percent, while China's ambitious renewable energy law stands a good chance of jumpstarting wind power, biofuels, and other new energy options.
- Seeking to provide mass mobility to over a billion people without diverting resources required to meet other human needs, the Chinese Ministry of Construction recently declared public transport a national priority and is promoting Bus Rapid Transit (BRT).
- In India, where 43 percent of the annual rain and snowfall fails to reach rivers and aquifers, NGOs have championed water harvesting, using simple technologies that capture and store water before it can flow away. In Chennai, the country's fourth largest city, some 70,000 buildings harvest rainwater.
- In 2004, China implemented automobile fuel economy standards that are based on European standards and tougher than those in the United States. China's commitment to energy efficiency is also reflected in its status as the world leader in producing and installing compact fluorescent light bulbs.
- Indian officials recently replicated successful small-scale biodiesel programs in 100 addiotional villages in the hopes of bringing revenue to depressed rural communities while powering local electrical grids and irrigation pumps.
- New laws in 2004 gave Chinese non-governmental organizations (NGOs) stronger legal standing to participate in policy decision-making. There are now more than 2,000 environmental NGOs in China – a sector that barely existed as recently as early 1990s.

Source-State of the World 2006, Worldwatch Institute

7. Notable Trends in China and India

- India already has the fourth largest wind power industry, while China and India are the third and fourth largest ethanol producers, respectively. Both countries have vast land areas that contain a large dispersed and diverse portfolio of renewable energy sources that are attracting foreign and domestic investment.
- The United States, Europe, Japan, India and China together claim 75 percent of the Earth's "biocapacity", investment.
- The average person in China has an ecological footprint of 1.6 global hectares, and, in India, 0.8 global hectares. In contrast, the average person in the United States has an ecological footprint of 9.7 hectares, and that footprint grew by 21 percent between 1992 and 2002.

Source-Worldwatch Institute

Feedback

We would appreciate if you send us comments and suggestions.

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Director

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