

Final Bulletin

International Commission
on Large Dams

12-16 August 2013
Seattle, Washington USA



81st Annual Meeting
www.icold2013.org

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Local Host



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Dear Delegates and Guests of the 81st Annual Meeting of ICOLD:

On behalf of the members of the United States Society on Dams, I am pleased to extend this invitation to worldwide experts in dams to join us in Seattle, Washington, USA on 12-16 August 2013, for the 81st Annual Meeting of the International Commission on Large Dams. This event offers extraordinary opportunities to our colleagues involved with the development, operation and maintenance of critical water resource infrastructure for dams around the world to share our knowledge and lessons learned.

The 81st Annual Meeting of ICOLD will be held in scenic downtown Seattle, Washington, with easy access to the airport, shopping, cultural sites and general tourist places of interest. We are excited about the opportunity to host our ICOLD colleagues in the United States for the first time since the 1988 Congress.

The sustainable development of renewable resources with environmental stewardship is of great importance as developed and developing countries alike seek to strengthen and maintain critical infrastructure. The United States has almost 85,000 dams that deliver a broad array of benefits, including water and power supply, flood risk management, water quality, recreation, sedimentation control, and other benefits for our citizens.

The United States is pleased to host this international meeting to facilitate discussion and the exchange of information on these important topics and share key technological advances by the engineers and scientists in attendance. I encourage you also to consider one of the exciting pre- or post-meeting tours of dams in the United States that are offered. We look forward to seeing you in Seattle.

Michael F. Rogers
President, United States Society on Dams and
Chairman, ICOLD 2013 Organizing Committee



www.usdams.org

Dear Delegates and Guests of the 81st Annual Meeting of ICOLD:

It is a great pleasure and honor for me to invite, on behalf of ICOLD, delegates of the National Committees of ICOLD, specialists and experts in dams, and accompanying persons to the 81st Annual Meeting of ICOLD and the international symposium that will be held in Seattle (Washington State), in the United States, from 12 August through 16 August 2013. This meeting will take place in the beautiful city of Seattle, home to some of the most advanced industries and technologies in the world, and located in one of the areas of the United States that has known important developments in dams and reservoirs throughout its history.



The 81st Annual Meeting will be held in a country that was a pioneer in dam and reservoir construction for all uses, such as power generation, the irrigation of millions of acres, navigation, tourism, ecology, recreation activities, etc. With more than 80,000 dams, the United States is among the countries that have built large numbers of dams and reservoirs as part of infrastructures that have allowed those countries to reach their high level of development and meet the ever increasing needs and new demands of their population, as well as to ensure their protection against the effects of floods and droughts, and the protection of their environment and ecosystems.

Throughout this process, American professionals, thanks in part to the United States Society on Dams, have accumulated a rich experience that participants at the 81st Annual Meeting will be able to share through exchanges and work during the various activities, including the Symposium on the topic: “Changing Times: Infrastructure Development to Infrastructure Management,” which refers to the maintenance, improvement and life extension of dams and reservoirs, the inspection, security, and safety of dams, etc.

The International Commission on Large Dams was created in 1928 and now includes 95 national member organizations on five continents. Since its creation, the Commission has been working tirelessly by publishing technical bulletins based on the work of technical committees, conferences and their proceedings, world charters and statements, symposiums, forums and other pronouncements so that dams are designed, built, operated and maintained in a way that is secure, economical, and respectful of the environment and of social equity.

At the 81st Annual Meeting in Seattle, in addition to the General Assembly, which will focus on ICOLD’s inner workings as well as measures for its continued strengthening to enable the organization to face the challenges of a deeply changing world, there will be work sessions of ICOLD’s technical committees, the activities of the forums of young engineers, workshops organized by the United States Society on Dams, a technical exhibition and technical tours. These technical tours will allow participants to explore the United States’ accomplishments in terms of dams, facilities and water and energy resource management, and to discover the people, cultures and wonderful nature of the United States of America.

In addition to the Symposium, the United States Society on Dams will innovate this year by offering professionals coming to Seattle the opportunity to participate in various technical workshops on topics as interesting and varied as managing risks associated with dams, the aging of concrete dams, spillway improvements, etc.

I strongly encourage you to come to Seattle in August 2013, where ICOLD and the United States Society on Dams will be happy to welcome you and make your stay enjoyable and productive.

Adama Nombre
President, ICOLD

To the Nations of the International Commission on Large Dams:

On behalf of the United States of America, it is my pleasure to extend an invitation to the international community to join the 81st Annual Meeting of the International Commission on Large Dams (ICOLD) in Seattle, Washington, on 12-16 August 2013.

Over eighty years have passed since the first ICOLD World Congress gathered in Stockholm. Much has changed since then, yet ICOLD's mission to advance the art and science of dams is as relevant today as it was in 1929. As we have seen around the world, the sustainable development of renewable resources through the development of infrastructure remains a priority, both in developed and developing countries alike.

The United States is pleased to host this international meeting to facilitate discussion, exchange information and share key technological advances. We look forward to sharing our vast experience and lessons learned from building and maintaining almost 85,000 dams that have delivered a broad array of benefits for our citizens. I encourage international participants to share in this knowledge, and hope that your tours of U.S. dams and infrastructure following the meeting will be instructive and enjoyable.

As one of the original founding member countries of ICOLD, we are honored to have been selected to host this important meeting and we look forward to welcoming you to Seattle. Our Federal agencies, private sector partners and the people of the United States of America are eager to extend our most gracious hospitality and friendship.

Michael L. Connor, Commissioner, U.S. Bureau of Reclamation



To the Delegates and Guests of the 81st Annual Meeting of ICOLD:

On behalf of the great city of Seattle, I am delighted to welcome you to the 81st ICOLD Annual Meeting that will be held in August 2013. We warmly welcome you and your families to this important ICOLD Meeting on dam engineering, construction, operation and maintenance.

Created by the citizens of Seattle in 1902, Seattle City Light has served our customers with electricity and related services for more than a century. Over the years we have worked very hard to keep Seattle's electricity affordable, reliable, and environmentally sound. In 2010, energy from clean and efficient hydropower accounted for more than 92% of the electricity provided to our customers. Today Seattle City Light is a recognized national leader in energy efficiency and environmental stewardship.

Seattle is a vibrant, modern city with many great tourist places, shops and attractions. We invite you and your family to take time during your stay with us to visit our many exciting museums, stores and recreational attractions. We hope that you will take advantage of the local City Tour, Technical Tours of local interest, and Accompanying Persons Tours of the local culture as part of the ICOLD Meeting. More information about our city can be found on the Internet at <http://www.seattle.gov/visiting/>.

Enjoy your stay in Seattle; return home with only fond memories of your visit; and hopefully, some day you will find an occasion to return to our magnificent city in the majestic Pacific Northwest of the United States.

Jorge Carrasco, Superintendent, Seattle City Light



The International Commission on Large Dams (ICOLD) is a non-governmental organization that provides a forum for exchange of knowledge and experience in dam engineering, construction and operation at the international level. ICOLD leads the profession in ensuring that dams are built safely, efficiently, economically and without detrimental effects for the environment. ICOLD was founded in 1928 and includes 95 National Committees.

Board

President

A. Nombre (Burkina Faso, 2012-2015)

Secretary General

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A. Pujol (Argentina, 2011-2014)

G. Basson (South Africa, 2012-2015)

National Committees

- | | | | |
|------------------------------------|---|-----------------|--------------------|
| 1. Albania | 24. Dominican Republic | 47. Latvia | 72. Russia |
| 2. Algeria | 25. Egypt | 48. Lebanon | 73. Serbia |
| 3. Argentina | 26. Ethiopia | 49. Lesotho | 74. Slovakia |
| 4. Armenia | 27. Finland | 50. Libya | 75. Slovenia |
| 5. Australia | 28. Former Yugoslav Republic of Macedonia | 51. Luxemburg | 76. South Africa |
| 6. Austria | 29. France | 52. Madagascar | 77. Spain |
| 7. Belgium | 30. Georgia | 53. Malaysia | 78. Sri Lanka |
| 8. Bolivia | 31. Germany | 54. Mali | 79. Sudan |
| 9. Bosnia-Herzegovina | 32. Ghana | 55. Mexico | 80. Sweden |
| 10. Brazil | 33. Greece | 56. Morocco | 81. Switzerland |
| 11. Bulgaria | 34. Guatemala | 57. Mozambique | 82. Syria |
| 12. Burkina Faso | 35. Honduras | 58. Nepal | 83. Tajikistan |
| 13. Cameroon | 36. Iceland | 59. Netherlands | 84. Thailand |
| 14. Canada | 37. India | 60. New Zealand | 85. Tunisia |
| 15. Chile | 38. Indonesia | 61. Niger | 86. Turkey |
| 16. China | 39. Iran | 62. Nigeria | 87. Ukraine |
| 17. Colombia | 40. Iraq | 63. Norway | 88. United Kingdom |
| 18. Congo (Democratic Republic of) | 41. Ireland | 64. Pakistan | 89. Uruguay |
| 19. Costa Rica | 42. Italy | 65. Panama | 90. USA |
| 20. Croatia | 43. Ivory Coast | 66. Paraguay | 91. Uzbekistan |
| 21. Cyprus | 44. Japan | 67. Peru | 92. Venezuela |
| 22. Czech Republic | 45. Kenya | 68. Philippines | 93. Vietnam |
| 23. Denmark | 46. Korea | 69. Poland | 94. Zambia |
| | | 70. Portugal | 95. Zimbabwe |
| | | 71. Romania | |

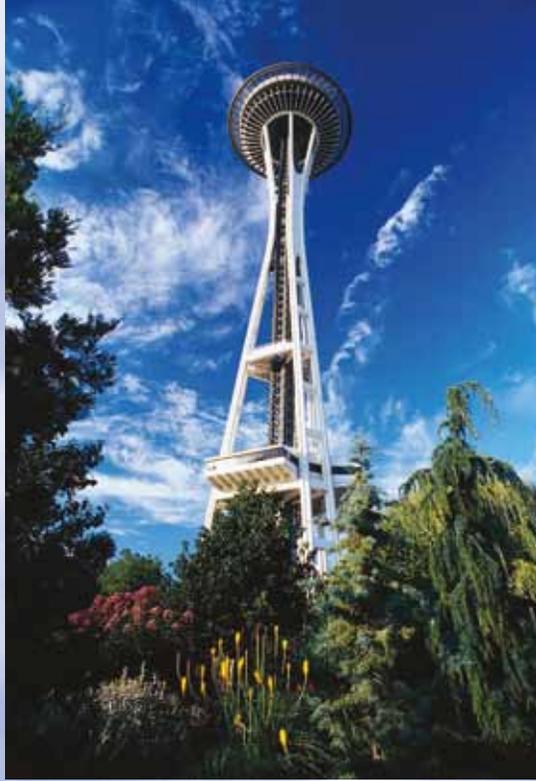
Technical Committees

- | | | |
|---|--|--|
| A Computational Aspects of Analysis and Design of Dams | I Public Safety Around Dams | O World Register of Dams and Documentation |
| B Seismic Aspects of Dam Design | J Sedimentation of Reservoirs | Q Dam Surveillance |
| C Hydraulics for Dams | K Integrated Operation of Hydropower Stations and Reservoirs | S On Flood Evaluation and Dam Safety |
| D Concrete Dams | L Tailings Dams & Waste Lagoons | U Dams and River Basin Management |
| E Embankment Dams | M Operation, Maintenance and Rehabilitation Of Dams | X Financial and Advisory |
| F Engineering Activities with the Planning Process for Water Resources Projects | N Public Awareness and Education | Y Climate Change |
| G Environment | | Z Capacity Building and Dams |
| H Dam Safety | | |

Welcome to Seattle!

The U.S. Society on Dams welcomes ICOLD to the United States of America for the 81st Annual Meeting. The meeting will be held 12-16 August 2013, in Seattle, Washington, USA. USSD selected Seattle for its location in the beautiful Pacific Northwest part of the country, proximity to major dams and hydroelectric projects, and the proximity of many attractive tourist opportunities. Mid-August is a perfect time to visit this lovely city and surrounding area, with favorable weather and many activities in the downtown area.

Dams and water resources play a key role in the history and economy of the region. There are more than 1,200 dams in the state of Washington, and with approximately 80,000 kilometers of rivers and streams; 7,800 lakes and 5,000 kilometers of coastline, water is an essential resource for the economic, social and cultural well-being of the state. The state of Washington leads the nation in hydroelectricity, with about 87 percent of its electricity produced by hydroelectric facilities. In fact, approximately 31 percent of the United States' total hydropower is generated in Washington.



Seattle, The Emerald City

With an area population of more than 3.2 million people, Seattle is the major economic, cultural and educational center of the Pacific Northwest. A major Pacific Ocean seaport, Seattle is situated on an isthmus between Puget Sound and Lake Washington about 180 kilometers south of the U.S. – Canadian border. Seattle is known for its mild and rainy climate, but during the summer, the weather is generally dry and warm. With hundreds of daily flights by 25 major national and international airlines, the Seattle-Tacoma International Airport serves millions of travelers each year.

While in the city, visitors can enjoy a 360 degree view of the city from the top of the Space Needle, stroll through the historic Pike Place Market, see 300 species of

marine life at the Seattle Aquarium or ride on the world's third largest ferry system to nearby islands. Seattle offers a variety of dining options guaranteed to please your palate, from fresh-off-the-boat seafood and locally grown produce to world renowned wines and coffee from the first independent coffee stand in history. With more than 200 art galleries, a variety of performing arts, five professional sports teams and countless outdoor activities, Seattle promises a truly remarkable experience for everyone.



Sheraton Seattle Hotel — Meeting Venue and Headquarters Hotel



The 35-story Sheraton Seattle Hotel is in the heart of downtown Seattle with breathtaking views of the Seattle skyline. The Sheraton will serve as the venue for ICOLD committee meetings, the Symposium, workshops, exhibition and Executive Meeting. The ICOLD 2013 Conference Welcome Reception and Farewell Dinner will also be held at the Sheraton Hotel.

The Sheraton features in-room Wi-Fi access, business center, state-of-the-art fitness center with spa and whirlpool, and a restaurant, carry-out breakfast and sandwich shop, and lounges. The Hotel's location in thriving downtown Seattle means guests are just steps from exciting nightlife, restaurants, shopping, and entertainment. Walk or take convenient public transportation to Seattle's famous attractions, including Pike Place Market, the Seattle Waterfront, Seattle Center, Space Needle, Seattle Art Museum, Seattle Aquarium, Washington State Convention & Trade Center and the Washington State Ferries.

Hotel Reservations

You must make your own hotel reservations in Seattle. The Sheraton Hotel is the only official ICOLD hotel. Call 888-627-7056 (U.S. toll free), 1-206-447-5534, or go online at <https://www.starwoodmeeting.com/StarGroupsWeb/res?id=1212143449&key=8BC71> to reserve a room at the Sheraton Seattle Hotel at the special group rate of US\$159 single or double (plus tax, currently 15.6%).

All ICOLD 2013 guests are strongly encouraged to stay at the Sheraton Hotel. A large number of rooms have been blocked at the special ICOLD rate; however, please reserve your room early to ensure availability. The room block rate is guaranteed only through 11 July (17:00 local time), or until the room block fills. Reservations after 11 July will be at the prevailing room rate, subject to availability.

The Sheraton Seattle Hotel
1400 6th Avenue, Seattle, WA 90101
1-206-621-9000/www.sheraton.com/seattle

Breakfast Option

As is the custom in the U.S., breakfast is not included in the room rate at the Sheraton. You may choose to purchase a full breakfast, served from 06:30 to 09:00 Monday through Friday in the Sheraton Hotel, for ICOLD delegates and Accompanying Persons only. Each breakfast is US\$30 per person per day. This option is available only on the ICOLD 2013 Registration Form; it is not offered by the hotel. For those who do not select the breakfast option, the hotel restaurant serves a full breakfast, and a snack bar has quick “grab and go” breakfasts. In addition, there are many restaurants and coffee shops within a 2-10 minute walk from the hotel for you to enjoy breakfast on your own.

Budget Accommodations

The group rate secured at the Sheraton Hotel is very competitive for downtown Seattle during August. However, for those seeking budget accommodations, please contact City Hostel Seattle, www.cityhostelseattle.com, phone 1-206-706-3255. City Hostel Seattle is within walking distance of the Sheraton Hotel. Hostel beds and rooms fill quickly during the summer months, so you are encouraged to make your reservations early. Rates range from US\$28 to US\$73 per night and include breakfast.



Delegates may also purchase the optional tours (AP1-AP17) listed on the following page.

Date	Time	Events Open to Delegates	
Sunday 11 August	08:00 – 17:00	REGISTRATION	
	09:00 – 17:00	Meeting of ICOLD Board	
	13:30 – 16:30	City Tour I	
Monday 12 August	08:00 – 17:00	REGISTRATION	
	09:00 – 12:00	Meeting of ICOLD Board & Technical Committee Chairs	
	09:00 – 12:00	City Tour II	
	10:00 – 12:00	Young Engineers Forum	
	13:30 – 16:30	City Tour III	
	13:00 – 17:00	Technical Committee Meetings	
	18:00 18:00 – 20:00	EXHIBITION – OPENING CEREMONY Welcome Reception	
Tuesday 13 August	08:00 – 17:00	REGISTRATION	
	08:00 – 12:00	Technical Committee Meetings	
	08:00 – 17:00	EXHIBITION HALL OPEN	
	12:00 – 13:00	Lunch in Exhibit Hall	
	13:00 – 16:30	Technical Committee Meetings	
	17:00 – 20:00	ICOLD Club Meetings	
	Wednesday 14 August	08:00 – 17:00	REGISTRATION
08:00 – 18:00		EXHIBITION HALL OPEN	
07:45 – 09:30		Symposium Opening Plenary Session	
07:45 – 17:00		Symposium Poster Session A	
09:30 – 10:00		Break in Exhibit Hall	
10:00 – 11:00		Symposium Keynote Plenary Session	
11:00 – 12:00		Lunch in Exhibit Hall	
12:00 – 14:45		Symposium Concurrent Sessions	
14:45 – 15:30		Break in Exhibit Hall	
15:30 – 18:00		Symposium Concurrent Sessions	
18:00 – 20:00		Cultural Event: Seattle Art Museum	
Thursday 15 August		07:30 – 17:30	TT 1: Baker River Hydro Project (includes lunch)
		07:30 – 12:00	TT 2: Snoqualmie Falls
	07:30 – 17:00	TT 3: Cowlitz River Project (includes lunch)	
	07:30 – 17:00	TT 4: Cushman Hydro Project (includes lunch)	
	08:00 – 17:00	REGISTRATION	
	08:00 – 13:00	EXHIBITION HALL OPEN	
	08:00 – 12:00	Symposium Poster Session A	
	08:00 – 12:00	Workshop 1: Life Extension Technologies and Strategies	
	08:00 – 12:00	Workshop 2: Risk-Informed Dam Safety Management	
	08:45 – 12:00	TT 5: Hiram Chittenden Locks	
	09:30 – 12:00	TT 6: Alden Laboratory	
	12:00 – 13:00	Lunch in Exhibit Hall	
	13:00 – 17:00	Symposium Poster Session B	
	13:00 – 17:00	Workshop 3: Spillway and Reservoir Capacity Changes	
	13:00 – 17:00	Workshop 4: Aging of Concrete Dams	
	13:00 – 17:30	TT 7: Snoqualmie Falls	
	13:30 – 16:00	TT 8: Alden Laboratory	
13:30 – 16:45	TT 9: Hiram Chittenden Locks		
Friday 16 August	08:00 – 17:00	REGISTRATION	
	08:00 – 17:00	Symposium Poster Session B	
	08:00 – 12:00	Workshop 5: Technologies for Monitoring Dams and Levees	
	08:00 – 12:00	Workshop 6: Closure of Tailings Dams	
	09:00 – 12:00	81st GENERAL ASSEMBLY	
	12:00 – 13:00	Lunch (Workshop Participants)	
	12:00 – 14:00	Lunch (General Assembly Participants)	
	13:00 – 17:00	Workshop 7: Levees and Embankments	
	13:00 – 17:00	Workshop 8: Decommissioning Dams	
	13:00 – 17:00	Workshop 9: Seismic Analysis of Embankment Dams	
	14:00 – 17:00 19:00 – 21:00	81st GENERAL ASSEMBLY Farewell Dinner	

Date	Time	Optional Tours and Events Open to Accompanying Persons	
Sunday 11 August	08:00 – 17:00	REGISTRATION	
	13:30 – 16:30	City Tour I	no charge
Monday 12 August	08:00 – 08:45	History of Seattle/Tour Orientation	no charge
	08:00 – 17:00	REGISTRATION	
	09:00 – 12:00	City Tour II	no charge
	13:30 – 16:30	City Tour III	no charge
	18:00 – 20:00	Welcome Reception	no charge
Tuesday 13 August	08:00 – 17:00	REGISTRATION	
	08:00 – 17:00	EXHIBITION HALL OPEN	
	08:15 – 12:15	AP 1: Lakes and Locks Cruise (no meal)	US\$65
	09:00 – 12:00	AP 2: Downtown Walking Tour (no meal)	US\$25
	09:00 – 12:30	AP 3: Future of Flight and Boeing (no meal)	US\$50
	11:00 – 15:00	AP 4: Tillicum Village (with lunch)	US\$125
	12:00 – 13:00	LUNCH IN EXHIBIT HALL	
	12:30 – 16:30	AP 5: EMP, Chihuly Glass Museum, Space Needle (no meal)	US\$75
	12:15 – 16:45	AP 6: Snoqualmie Falls, Boehm's Chocolates (with lunch)	US\$100
	13:00 – 16:00	AP 7: Downtown Walking Tour (no meal)	US\$25
Wednesday 14 August	08:00 – 17:00	REGISTRATION	
	08:00 – 18:00	EXHIBITION HALL OPEN	
	08:15 – 12:15	AP 8: Lakes and Locks Cruise (no meal)	US\$65
	09:00 – 12:00	AP 9: Downtown Walking Tour (no meal)	US\$25
	09:00 – 14:00	AP 10: Northwest Wineries (with lunch)	US\$75
	11:00 – 15:00	AP 11: Tillicum Village (with lunch)	US\$125
	11:00 – 12:00	LUNCH IN EXHIBIT HALL	
	12:15 – 16:45	AP 12: Snoqualmie Falls, Boehm's Chocolates (with lunch)	US\$100
	13:00 – 16:30	AP 13: Future of Flight and Boeing (no meal)	US\$50
	18:00 – 20:00	Cultural Event: Seattle Art Museum	no charge
Thursday 15 August	07:30 – 17:30	TT 1: Baker River Hydro Project (with lunch)	no charge
	07:30 – 12:00	TT 2: Snoqualmie Falls (no meal)	no charge
	07:30 – 17:00	TT 3: Cowlitz River Project (with lunch)	no charge
	07:30 – 17:00	TT 4: Cushman Hydro Project (with lunch)	no charge
	08:00 – 17:00	REGISTRATION	
	08:00 – 13:00	EXHIBITION HALL OPEN	
	08:45 – 12:00	TT 5: Hiram Chittenden Locks (no meal)	no charge
	09:30 – 12:00	TT 6: Alden Laboratory (no meal)	no charge
	12:00 – 13:00	LUNCH IN EXHIBIT HALL	
	13:00 – 17:30	TT 7: Snoqualmie Falls (no meal)	no charge
13:00 – 16:30	TT 8: Alden Laboratory (no meal)	no charge	
13:30 – 16:45	TT 9: Hiram Chittenden Locks (no meal)	no charge	
Friday 16 August	08:00 – 17:00	REGISTRATION	
	09:00 – 14:00	AP 14: Northwest Wineries (with lunch)	US\$75
	11:00 – 15:00	AP 15: Tillicum Village (with lunch)	\$125
	12:30 – 16:30	AP 16: EMP, Chihuly Glass Museum, Space Needle (no meal)	US\$75
	13:00 – 16:30	AP 17: Future of Flight and Boeing (no meal)	US\$50
19:00 – 21:00	Farewell Dinner	no charge	

Wednesday,
14 August

The theme of the one-day Symposium recognizes that much of the world, including the United States, faces the challenges of managing an aging dam infrastructure during a time when sustainability, safety and security concerns are paramount. Concurrent sessions and two poster sessions will maximize opportunities for delegates to make presentations.

Changing Times: Infrastructure Development to Infrastructure Management

Symposium Topics

1. Technical Approaches for Managing an Aging Infrastructure
2. Advances in Dam Safety, Security, and Risk Management
3. Strategies for Extending Service Life of Dams
4. Innovative Surveillance and Monitoring Systems
5. Decommissioning Dams at the Completion of their Useful Service Life
6. Sustainable Hydropower Development

Symposium Agenda

Time	Session	Speaker
07:45 – 09:00	Opening Plenary Session Welcome and Introductions ICOLD Welcome Local Host Welcome Role of Dams & Hydro as Renewable Energy in Alaska	Michael F. Rogers, Chairman, ICOLD 2013 Adama Nombre, President, ICOLD Jorge Carrasco, Superintendant, Seattle City Light Sean Parnell, Governor, State of Alaska (invited)
09:00 – 09:30	Coffee Break in Exhibit Hall	
09:30 – 11:00	Keynote Plenary Session Challenges in Managing Water in the American West Role of Dams & Hydro as Renewable Energy in China Risk Management, U.S. Army Corps of Engineers	Michael L. Connor, Commissioner, U.S. Bureau of Reclamation Jia Jinseng, Past President, ICOLD Eric Halpin, U.S. Army Corps of Engineers
11:00 – 12:00	Lunch in Exhibit Hall	
12:00 – 14:45	Concurrent Technical Sessions	
14:45 – 15:30	Coffee Break in Exhibit Hall	
15:30 – 18:00	Concurrent Technical Sessions	

Poster Sessions — Additional papers will be presented in two Poster Sessions.

Poster Session	Begins	Ends
A	07:45 Wednesday, 14 August	12:00 Thursday, 15 August
B	13:00 Thursday, 15 August	17:00 Friday, 16 August

To encourage discussions between Poster Session authors and ICOLD 2013 delegates, times will be posted on each display indicating when the author will be available at the poster display.

Proceedings — The Symposium Proceedings will be distributed in electronic format to each ICOLD 2013 delegate. The Proceedings will include all papers accepted from the Call for Papers, including those presented during the technical sessions and the Poster Sessions, as well as those not selected for presentation. The Proceedings will include more than 400 papers.

Workshop

Life Extension Technologies and Strategies for Aging Dams
 Risk-Informed Dam Safety Management
 Managing Spillway and Reservoir Capacity Changes
 Aging of Concrete Dams
 State of the Art Technologies for Monitoring Dams and Levees
 Closure of Tailings Dams
 Best Practices in Levee and Embankment Technology
 Decommissioning Dams at Completion of their Useful Service Life
 Seismic Analysis of Embankment Dams

Day	Time
Thursday	08:00 – 12:00
Thursday	08:00 – 12:00
Thursday	13:00 – 17:00
Thursday	13:00 – 17:00
Friday	08:00 – 12:00
Friday	08:00 – 12:00
Friday	13:00 – 17:00
Friday	13:00 – 17:00
Friday	13:00 – 17:00

Thursday, 15 August

08:00 – 12:00 — Life Extension Technologies and Strategies for Aging Dams

This Workshop will provide attendees an understanding of how dam owners evaluate decisions relative to extending the life of a dam and new technologies and techniques that are used in the United States.

The Workshop will start with a panel discussion between senior engineers of large utility companies

about the decisions made to maintain, enhance, or remove dams. There are six case studies of unique upgrades to U.S. dams for embankment, outlet works, and spillway deficiencies, as well as upgrades to meet environmental requirements. The upgrades for embankments are for seismic and underseepage deficiencies. A significant component of the upgrade case studies is how to perform the required construction with minimal impact to the water resource. Leaving the reservoir full or nearly full can have significant financial benefits, but creates interesting construction conditions.



Baker Dam

08:00 – 12:00 — Risk-Informed Dam Safety Management

This Workshop will demonstrate how dam owners and regulators have transformed their approach to man dam safety through a risk-informed approach. The Workshop will begin with an overview of risk-informed dam safety management, how it builds on and strengthens traditional approaches to dam safety, and how it can integrate with the owner’s business. The Workshop will then draw from the experience of large public and private U.S. dam owners and dam safety regulators to provide more elaborate discussions on the development and implementation of risk-informed decision making for a portfolio of dams. Given the advancements of risk assessment in other countries, a foreign private dam owner and dam safety regulator will share their knowledge of risk-informed management. The Workshop will close with a discussion panel, consisting of presenters and risk-assessment experts, to address specific questions, expand on the discussion, and express their views on the challenges ahead for dam safety management.

Thursday, 15 August and Friday, 16 August

A program of nine half-day technical workshops on Thursday and Friday will highlight new developments and experiences in the long term management of dams. The workshops will focus on current “hot topics” which have been discussed extensively in the United States, and are of interest internationally. Each workshop session will be hosted by a USSD Technical Committee to discuss the issue from a domestic and international perspective.

Detailed agendas for each workshop are available from the ICOLD 2013 website at www.icold2013.org/workshops.html.

13:00 – 17:00 — Managing Spillway and Reservoir Capacity Changes

This Workshop will address challenges related to changes in spillway and reservoir capacity requirements at existing dams in the U.S. and other countries. The Workshop will explore the drivers that influence the need for capacity changes and the approaches being taken in the U.S. to address these changes. The Workshop will first cover the assessment and evaluation of spillway and reservoir capacity changes, including identifying the issues, performing dam evaluation and spillway operation reviews, and making the decision to rehabilitate. The Workshop will then examine the approaches to respond to spillway and reservoir capacity shortfalls, including spillway expansion to meet design flood requirements, use of physical and numerical models to evaluate spillway hydraulics, and consideration in selecting and designing spillway upgrades. The discussion will include the use of risk assessment in decision making, tools for analysis and design, typical retrofit options being used in the U.S., and other considerations in selecting spillway upgrades.

13:00 – 17:00 — Aging of Concrete Dams

Concrete dams change with time. Aging is often thought of in a negative context, but this is not always the case. This Workshop will identify common aging mechanisms that affect concrete dams, explain how concrete material properties change with time, and relate aging mechanisms to potential failure modes at dams. Some of the aging processes that will be examined include concrete deterioration mechanisms, reduced drain efficiency, erosion of the downstream foundation, gate reliability issues, and failure of waterstops. The Workshop will examine changing concrete properties with time, effects of aging on potential failure modes, and Aggregate Alkali Reaction (AAR) induced potential failure modes. The Workshop will conclude with case studies that explore the impact of key aging mechanisms on the safety of concrete dams.

Note: An optional post-meeting study tour will visit dams in southeastern states that have been affected by AAR (Post-Tour B4). The study tour includes an international workshop on AAR.

Friday, 16 August

08:00 – 12:00 — State of the Art Technologies for Monitoring Dams and Levees

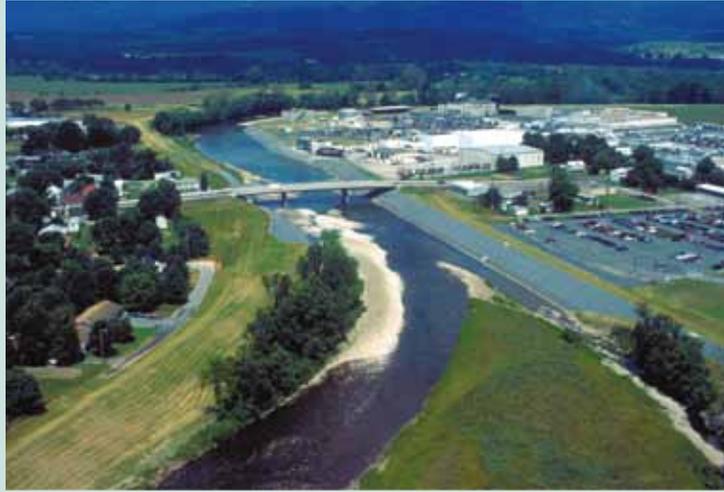
This Workshop will feature presentations and discussions about state-of-the-art technologies being used in dam safety monitoring. Speakers from a variety of backgrounds will share their perspectives on the following technologies: fiber optic temperature and strain sensing, geophysical methods, laser scanning, GPS and InSar for remote deformation measurements, and recent advances in traditional instrumentation methods (piezometers, data acquisition systems). A broad range of perspectives will be provided by the speakers, who will include a dam owner, a dam safety consultant, and an instrumentation and monitoring equipment vendor.

08:00 – 12:00 — Closure of Tailings Dams

This Workshop will focus on the challenges and emerging trends related to the closure of tailings dams. Presentations will include overviews of Sustainable Closure Principles, design criteria, and the regulatory environment in North America and internationally. The Workshop will then provide an overview of the design and regulatory aspects, and several case studies will be presented, focusing on closure water management, physical stability, ecological stability, and social stability and monitoring. The Workshop will conclude with an interactive panel discussion of tailings dam closure issues with USSD and ICOLD Tailings Dam Committee members.

13:00 – 17:00 — Best Practices in Levee and Embankment Technology

This Workshop will feature a fast-paced program of informative presentations on the current practices in levee and embankment technology. The series of 15-minute-long, relevant discussions will encompass hot topics that will provide owners, regulators and consultants with valuable, up-to-date



Moorewood, West Virginia, Levee

information on evolving hydraulic design criteria; geotechnical considerations, including aspects of seepage and stability design; application of risk assessment practices; the state of practice in penetrations and closures; and new developments from around the world, including Canada, Japan, the Netherlands, and the U.S. Following the presentations, there will be an update on the International Levee Handbook. The Workshop will conclude with a panel discussion.

13:00 – 17:00 — Decommissioning Dams at the Completion of their Useful Service Life

This Workshop will introduce the newly prepared USSD *Guidelines for Dam Decommissioning Projects* and features an overview of the document by two of its authors. Case studies will be presented for a series of small dam removal projects completed in the Western United States, followed by detailed discussions of the two largest dam removal projects completed to date—the Elwha River Restoration Project and Condit Dam Removal, both located in the state of Washington. The Workshop focus will then shift to the Eastern United States for another series of small dam removal projects. Each case study will include the project background, reason for dam removal, methods used for streamflow diversion and demolition, discussion of sediment management issues, and project costs. Two additional large dams in California that have reached the end of their useful service life and are slated for removal will then be examined. The Workshop will close with a presentation of dam removal projects outside the United States, followed by a discussion panel of all presenters to address specific questions from the audience.

13:00 – 17:00 — Seismic Analysis of Embankment Dams

The Workshop will provide an overview of current U.S. practices for the seismic analysis of embankment dams, including characterization of earthquake ground motions for dam analysis. The presentations will first examine earthquake ground motions, the analysis framework, and static stress analysis. Expanding on these basic principles, the Workshop will examine dynamic response analysis, liquefaction and post-earthquake stability, and seismic stability and deformation. The analysis procedures will be illustrated through examples and/or case studies.

An Exhibition will be held 12-15 August at the Sheraton Seattle Hotel. The Exhibition will provide an opportunity for U.S. and international companies and organizations to showcase achievements, products and services related to the design, construction, operation and maintenance, and safety of dams. The exhibition is sold out — please visit www.icold2013.org/exhibition to see a list of exhibitors.

Exhibit Hours

Monday, 12 August

18:00 — Exhibition Opening Ceremony

18:00 – 20:00 — Welcome Reception/
Exhibition Open

Tuesday, 13 August

08:00 – 17:00 — Exhibition Open

Morning and afternoon breaks in exhibit hall

12:00 – 13:00 — Lunch in exhibit hall

Wednesday, 14 August

08:00 – 18:00 — Exhibition Open

09:00 – 09:30 — Coffee Break in exhibit hall

11:00 – 12:00 — Lunch in exhibit hall

14:45 – 15:30 — Coffee Break in exhibit hall

Thursday, 15 August

08:00 – 13:00 — Exhibition Open

Morning break in exhibit hall

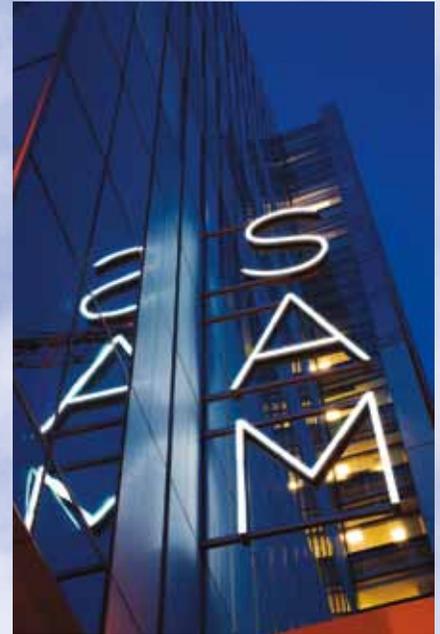
12:00 – 13:00 — Lunch in exhibit hall

13:00 — Exhibition closes

Wednesday, 14 August

On Wednesday evening, USSD is pleased to host a cultural event to take a break from the heavy technical program. You will enjoy a spectacular evening at the Seattle Art Museum (SAM). SAM is known locally and internationally for its diverse collections, especially in Asian, African, Northwest Coast Native American and modern/contemporary art. SAM will be open exclusively for our ICOLD guests, providing access to all collections and special exhibitions. Refreshments and musical entertainment will add to the museum's incredible ambience. This Cultural Event will be open from 18:00 – 20:00. This will be an "Open House" event with no specific program or performance scheduled. Therefore, ICOLD guests should feel free to arrive and depart any time during this two-hour period.

The Seattle Art Museum is a 10 to 15-minute walk from the Sheraton, and you are encouraged to enjoy the short walk through downtown Seattle. USSD will provide hosts along the walking route to direct guests and offer assistance. Also, a motorcoach will be available, if needed, to provide transportation for those who are unable to walk to the museum.



Sunday, 11 August and Monday, 12 August

The City Tour of downtown Seattle is included in the registration fee for both delegates and accompanying persons. The three-hour motorcoach tour will be offered at three different times:

Tour	Day	Time
I	Sunday	13:00 – 16:30
II	Monday	09:00 – 12:00
III	Monday	13:30 – 16:30

A knowledgeable local guide will be on each motorcoach to introduce participants to Seattle's historical, cultural and sightseeing highlights. All tours will be in English.

Motorcoaches will make brief stops at the following landmarks:

Pike Place Market — internationally recognized as America's premier farmers' market and home to more than 200 year-round commercial businesses; hundreds of craftspeople and farmers who rent table space by the day and 240 street performers and musicians. The Market attracts 10 million visitors a year, making it one of Washington's most frequently visited destinations. Enjoy a delicious beverage at the original Starbucks. Snap a picture of the famous fish mongers at Pike Place Market and maybe even throw a fish yourself!

Olympic Sculpture Park — explore the dynamic spaces and layout of this waterfront park.

Pioneer Square — featuring more than 20 city blocks of Victorian Romanesque architecture and more than 30 fine art and glass galleries.

Learn about Seattle's fascinating history and culture as you pass by several Seattle landmarks, including **Downtown**, the **International District** and the **Space Needle** (Seattle's most recognizable landmark).



**Thursday,
15 August**

Technical Tours will be offered on Thursday, 15 August, providing an opportunity for participants and guests to visit dams and water resources facilities near Seattle. Each tour is of limited capacity; please register early. Also, please note that four half-day Workshops will also be held on Thursday; if you wish to attend a Workshop, please do not register for a Technical Tour that is held at the same time. Several Technical Tours are half-day tours, either morning or afternoon, allowing participants to attend both a Workshop or Technical Tour.

Baker River Hydroelectric Project

TT 1 — 07:30 – 17:30

Puget Sound Energy's largest hydropower facility is the Baker River Hydroelectric Project, located on a tributary of the Skagit River in northwest Washington. The project has two dams, each with its own powerhouse. The dams' reservoirs, Baker Lake and Lake Shannon, are fed by runoff from the flanks of Mount Baker and Mount Shuksan. Lower Baker Dam, completed in 1925, is an 87 meter high concrete structure with 83 megawatts in Powerhouse 3, and 30 megawatts within Powerhouse 4. The 90 meter high Upper Baker Dam, completed in 1959, has a generating capacity of 91 megawatts. The power project also contains extensive salmon enhancing systems, including a new fish hatchery and new, innovative facilities for moving migrating fish both upstream and downstream around PSE's two dams. The project provides numerous amenities for public recreation and flood control for communities in the Skagit River Valley. In the past five years the project has seen major projects restoration and enhancement as part of a new re-license. The tour will include new upstream Fish Trap passage, Floating Surface Collector downstream fish passage and Hatchery, which is state of the art; the new Powerhouse 4; and Upper Baker Dam. Lunch will be provided at the project site.



Snoqualmie Falls Hydroelectric Project

TT2 — 07:30 – 12:00

TT7 — 13:00 – 17:30



The world's first hydropower plant built completely underground, Puget Sound Energy's Snoqualmie Falls Hydroelectric Project was constructed in 1898 in the Cascade Mountain foothills east of Seattle. The project's original Plant 1 Powerhouse lies inside a bedrock cavity 82 meters below ground along the edge of Snoqualmie Falls. The project's public park and trails are one of the Northwest's favorite tourist

destinations. The entire project is undergoing major multi-year redevelopment scheduled for substantial completion in August 2013. The work includes substantial upgrades to PSE's power-generating infrastructure and enhancements to the public recreational facilities at Snoqualmie Falls. The tour will include the rebuild Plant 2 Powerhouse; overview of the replacement dam and powerhouse cavity and intakes; and the outdoor cavity museum and park facilities.

Cowlitz River Project

TT3 — 07:30 – 17:00

Tacoma Power's largest electricity generating facility, the Cowlitz River Project's installed capacity is 462 MW. The project includes two dams. Built in 1963, Mayfield Dam is a concrete arch/gravity and embankment dam, with a height of 61 meters above the riverbed and a length of 259 meters.



Mossyrock Dam, completed in 1968, is a concrete arch/ gravity and embankment dam with a height of 111 meters above the riverbed and a length of 502 meters. It is the tallest dam in Washington state, and about 1/3-meter taller the Space Needle! The Cowlitz River Project provides outstanding recreational opportunities, more than 5,000 hectares for wildlife habitat and a fisheries program involving two major hatcheries. A new license for operating Cowlitz River project was issued in 2002. The emphasis of the license is the restoration and recovery of wild salmon runs in the Cowlitz River. Tour participants will enjoy hands-on activities at the Cowlitz Salmon Hatchery. Lunch will be provided at the project site.

Cushman Hydro Project

TT4 — 07:30 – 17:00

The Cushman Hydro Project, owned and operated by Tacoma Power, was one of the first major dams in the Pacific Northwest. Completed in 1925, Cushman Dam No. 1, a concrete arch/gravity and embankment dam, rise 72 meters above the river, with a length of 339 meters. Just downstream, Cushman Dam No. 2 was completed in 1930 and is a 53-meter-high concrete arch/gravity dam with a length of 175 meters. The new fish bypass system and powerhouse at Cushman Dam No. 2 will be highlighted during the tour. On January 12, 2009, Tacoma Power, the Skokomish Tribe and federal agencies signed a settlement agreement that resolved long-standing disputes over the terms of a long-term license for the Project. The Federal Energy Regulatory Commission issued a long term license to the Project, completing a 34-year relicensing process. Lunch will be provided at the project site.



Alden Research Laboratory

TT6 — 09:30 – 12:00

TT8 — 13:30 – 16:00

Alden has a physical hydraulic modeling laboratory in Redmond, a suburb of Seattle. The lab is one of the few fully equipped commercial hydraulic laboratories in the world. Alden undertakes many hydraulic modeling projects, ranging from pumping station, pipeline, intake, spillways, inlet and outlet structure design, to sediment management, fish passage and high head dam and navigation facilities evaluations, simultaneously. Many other specialized investigations are performed to develop designs of any type of conduit or conveyance channel or control structure where flowing water is involved. The laboratory will display a physical model of the Boundary Dam and other hydraulic structure models.



Ballard (Hiram Chittenden) Locks

TT5 — 08:45 – 12:00

TT9 — 13:30 – 16:45

Ballard Locks are part of Seattle's Lake Washington Ship Canal. The locks and associated facilities maintain the water level of the fresh water Lake Washington and Lake Union; prevent the mixing of sea water from Puget Sound with the fresh water of the lakes; and move boats from the water level of the lakes to the water level of Puget Sound, and vice versa. The complex



includes two locks, a 71.6-meter spillway with six gates and a fish ladder to assist the migration of anadromous fish, notably salmon. Operated by the U.S. Army Corps of Engineers, the locks were formally opened on July 4, 1917. The tour will be led by Corps of Engineers staff from the Seattle District.

Accompanying Person Program and Optional Tours

A comprehensive program for Accompanying Persons (see Page 11 – Program for details) will allow guests to participate in many ICOLD activities while experiencing the beauty and culture of the Seattle area. A City Tour, the Welcome Reception, Exhibition, Cultural Event at the Seattle Art Museum, Technical Tour (choose one of nine options) and Farewell Dinner are included in the registration fee for Accompanying Persons.

An ICOLD Guest Hospitality Room will be available on the main floor in the Sheraton Hotel from 08:00 to 17:00 Sunday through Friday. It is envisioned that this Hospitality Room will provide a venue for meeting and greeting fellow Accompanying Persons. USSD will provide a Hospitality Room host to answer questions and provide assistance, if needed. A special presentation will be made for Accompanying Persons in the Hospitality Room on Monday, 12 August, from 08:00 to 08:45. A representative from the local tour agency will present a video of the history of Seattle, discuss the available tour programs and answer any questions.

The following Optional Tours are offered to Accompanying Persons and Delegates for an additional fee. All tours are subject to cancellation if a minimum number of registrations is not met. You will be notified by 1 August if a tour is cancelled and your fees will be refunded in full. Every effort will be made to accommodate persons from a cancelled tour onto another tour.



Seattle Lakes and Locks Cruise

US\$65 (no meal)

AP1 — Tuesday, 08:15 – 12:15

AP8 — Wednesday, 08:15 – 12:15

Enjoy **Lake Union**, the houseboat communities of **Portage Bay** and a cruise past many homes of Seattle's rich and famous during this cruise. Your sailing begins in Lake Union and includes live narration pointing out fascinating history and interesting facts about the places you are seeing including the "Sleepless in Seattle" houseboat. The cruise continues under one of our state's three floating bridges and past the homes of some of the world's most well-known multi-millionaires. On the return from the Lakes, your private boat will journey through the **Hiram Chittenden Locks** and out into Puget Sound. Once you have arrived in Puget Sound and Shilshole Bay, there is a chance you will encounter whales and bald eagles. The cruise ends as you sail into Elliott Bay and the Seattle Waterfront.

Downtown Walking Tour

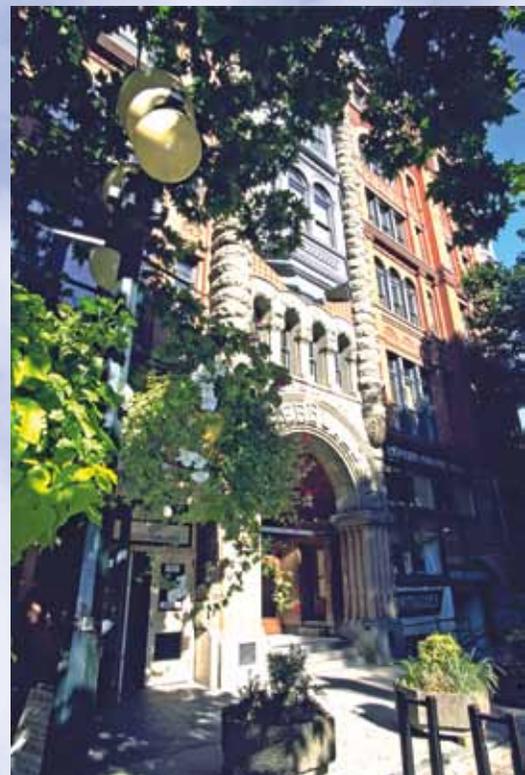
US\$25 (no meal)

AP2 — Tuesday, 09:00 – 12:00

AP7 — Tuesday, 13:00 – 16:00

AP9 — Wednesday, 09:00 – 12:00

This guided walking tour is an entertaining and informative introduction to Seattle's very walkable downtown. From the Seattle Sheraton, you are literally steps from the best shopping, activities and dining in the downtown core. Your stroll will take you through our **shopping district** anchored by the Nordstrom Flagship store, the **Theater District**, the world famous **Pike Place Market** and finally past many of Seattle's most **popular restaurants**. Don't forget your camera. There's a view at every turn!



Future of Flight and Boeing

US\$50 (no meal)

AP3 — Tuesday,
09:00 – 12:30

AP13 — Wednesday, 13:00 – 16:30

AP17 — Friday, 13:00 – 16:30

The **Future of Flight Aviation Center & Boeing Tour** features popular learning zones equipped with touch-screen computers that operate an educational program that guides you through the design of your own aircraft! As you experience the gallery, you will learn about the principal features of powered flight as well as the design and technological nuances of commercial airplanes at these interactive stations. You can then digitally create and test your own airliner designs. As part of the tour, visitors will experience the largest building in the world by volume. On the Boeing flight line, visitors will see airplanes in various stages of flight test and manufacture for airline customers around the world.



Tillicum Village

US\$125 (includes lunch)

AP4 — Tuesday,
11:00 – 15:00

AP11 — Wednesday,
11:00 – 15:00

AP15 — Friday,
11:00 – 15:00

Enjoy the vista of Seattle's spectacular cityscape during the 45-minute ferry boat cruise to **Blake Island** and **Tillicum Village**.

Blake Island State Park was an ancestral campground of the **Suquamish** and **Duwamish Indian Tribes** believed to be the birthplace of Chief Seattle. The island is a wonderful example of a Pacific Northwest lowland forest, with a saltwater beach circling the island park. Experience the heritage and culture of native Americans at the Tillicum Village Northwest Coast Indian Cultural Center. Following the stage show, guests are invited to a demonstration of how salmon are laced onto cedar cooking stakes to be barbecued around fire pits. Savor the **delicious salmon** during lunch on the Island.



EMP, Chihuly Glass, Space Needle

US\$75 (no meal)

AP5 — Tuesday, 12:30 – 16:30

AP16 — Friday, 12:30 – 16:30

Spend the afternoon in Seattle's premier art center where you will have time to visit the **EMP Museum (Experience Music Project)**, the newly opened **Chihuly Garden & Glass Exhibit** and Seattle's most iconic landmark, the Space Needle! EMP is dedicated to the exploration of creativity and innovation in popular music. Dale Chihuly is a native of Seattle and is recognized around the world for his beautiful blown



glass sculptures and installations. The Exhibition offers a comprehensive collection of Dale Chihuly's significant series of work. The centerpiece is the Glasshouse, glass and steel structure inspired by two of Chihuly's favorite buildings: Sainte-Chapelle in Paris and the Crystal Palace in London. The **Space Needle** was built for the 1962 World's Fair and remains one of the most recognizable landmarks in the world. From the Observation Deck located at 175 meters above the city, enjoy spectacular 360 degree views of Seattle and the surrounding region.



Snoqualmie Falls and Boehm's Chocolates

US\$100 (includes lunch)

AP6 — Tuesday, 12:15 – 16:45

AP12 — Wednesday, 12:15 – 16:45

At 82 meters tall, **Snoqualmie Falls** is surrounded by a park, hiking trails, observation deck, café and gift shop. Guests will be accompanied by a tour guide who will talk about the history of the area and share some of the interesting secrets Washington has to offer. Lunch with local Washington wines and microbrews will follow at the **Terrace at Salish Lodge** overlooking the Falls. During the tasting, a Sommelier will walk you through the different area wines and give a special presentation on the history of the wine and the menu item selected for the pairing. On your return, you will stop at the world famous **Boehm's Chocolates** in the small town of Issaquah, the original home of Julius Boehm, a transplanted Swiss Chocolatier. For decades, this kitchen has been a favorite sweet spot for visitors and locals alike!

Northwest Winery Tour

US\$75 (includes lunch)



AP 10 — Wednesday, 09:00 – 14:00

AP 14 — Friday, 09:00 – 14:00

As Washington State's oldest and most acclaimed winery, **Chateau Ste. Michelle** offers award-winning wines and a tasting experience second to none at the historic grounds 30 minutes outside of Seattle. The winery combines Old World winemaking tradition with New World innovation. You will take a tour of the Chateau, bottling line and the Barrel Room, ending with a "Theme Tasting" which will feature four of the winery's most popular Columbia Valley Wines. From the Chateau we will cross the street to the intimate, relaxed setting at **Novelty Hill Januik Winery** for a Columbia Valley wine tasting. This property is a unique, upscale destination for guests seeking a one-of-a-kind experience or memorable setting to mark a special occasion. The building's contemporary design and surrounding landscaping celebrate wine's agrarian roots and the artistry of fine winemaking. Wine tasting will include freshly made, brick oven artisan pizzas,

assorted Washington fruit and melon, baby green salad and selected cookies and mini-desserts.

Important Deadline: The deadline to register for a Study Tour is **1 May**. Tours that do not have a sufficient minimum registration by 1 May will be cancelled. Participants of any cancelled tours will have the opportunity to transfer to another Study Tour. Registrations for Study Tours after 1 May will be on a space available basis only.

All Study Tours fees include deluxe motorcoach transportation during the tour, hotels, entrance fees and most meals. Meals not included in the study tour fee are noted in the description of each tour.

Please note that airline tickets to or from the Study Tour originating destination (if applicable) are not included in the Study Tour fee. Please note the air transportation information included with each tour description.

Tour	Dates	Price/Person, Double Occupancy	Price, Single Occupancy
Pre-Tour A1 — North Cascade Mountains	11 August	NA	US\$160
Pre-Tour A2 — Elwha River Restoration Project	9 – 11 August	US\$550	US\$680
Pre-Tour A3 — San Francisco Bay Area Dams	7 – 10 August	US\$1100	US\$1530
Post-Tour B1 — Mid- and Upper- Columbia River Hydro Projects	17 – 19 August	US\$900	US\$1165
Post-Tour B2 — Lower Columbia River Dams and Mount St. Helens	17 – 19 August	US\$1000	US\$1265
Post-Tour B3 — Northern California Dams	17 – 21 August	US\$825	US\$1100
Post-Tour B4 — Southeastern U.S. Dams with Alkali-Aggregate Reactions and International Workshop	17 – 21 August	US\$900	US\$1130
Post-Tour B5 — Southern California Dams	17 – 21 August	US\$1300	US\$1800
Post-Tour B6 — Colorado River and the Grand Canyon	17 – 21 August	US\$975	US\$1260

Several study tours before and after ICOLD 2013 will showcase dams and the spectacular sights of western and southeastern regions of the United States. Participants will learn about contemporary issues facing dam engineers in the U.S. and throughout the world — issues such as modernization, seismic stability, safety and security, monitoring and instrumentation, even dam removal.

From forests to deserts, mountains to beaches, participants will soak up the gorgeous scenery of the U.S. and experience the bright lights of cities such as Las Vegas, San Francisco and San Diego. We're proud to have this opportunity to showcase meaningful U.S. dam projects in our beautiful country. Dam experts with extensive knowledge of the dams and water projects to be visited will accompany each Study Tour.



Pre-Tour A1 — North Cascade Mountains (Washington)

Sunday, 11 August (one day only), 07:30 to 20:00

Tour will begin and end at the Sheraton Seattle Hotel.

Tour Leader, Kimberly Pate, Seattle City Light

Price per person: US\$160 (Includes lunch, boat tour, wine tasting and dinner)

This pre-tour offers an outstanding opportunity to see the extraordinary beauty of Washington's North Cascade Mountains, and visit one of the most important and scenic hydropower projects in the Pacific Northwest. This affordable, one-day tour is perfect for those with time or financial constraints.

The Skagit River Hydroelectric Project is a series of three dams, owned and operated by Seattle City Light to provide electric power for the Seattle and surrounding communities. More than 90% of the power produced by the Skagit Project serves the city of Seattle and surrounding communities. The tour will feature a short stop at the Gorge Dam Overlook and/or Visitors Center, followed by a visit to the North Cascades Environmental Learning Center, on the shores of Diablo Lake, in beautiful North Cascades National Park. Seattle City Light staff will present information about the project, and lunch will be served in the North Cascades Institute dining hall. Following lunch, participants will experience the natural wonders of the mountains with a boat ride on Diablo Lake to the base of Ross Dam. The visit also includes a guided tour of Diablo Dam and Powerhouse, where you'll learn about the unique relationship between the environment and the three hydroelectric dams that provide clean, renewable power to the citizens of Seattle. The day will conclude with a visit to Challenger Ridge Vineyard & Cellars nestled in the foothills of the majestic North Cascade Mountain Range. Taste the winery's popular Pinot Noir wines and enjoy a dinner on the lovely property before returning to Seattle.

Study Tour Dams:

Gorge Dam. Construction began in 1921 and the first power was delivered to Seattle in 1924. The cost of the dam was US\$13 million. In 1961, the new 91-meter-high Gorge High Dam was completed, replacing the original dam.

Diablo Dam. Construction began in 1927, five miles upstream from Gorge Dam. Diablo Dam was completed in 1930, and at that time was the tallest dam in the world at 119 meters.

Ross Dam. Construction in 1937 and took place in three stages; the first stage was completed in 1940. The second and third stages were completed in 1953 when the dam was built to its final height of 165 meters.



Gorge Dam

Pre-Tour A2 — Elwha River Restoration Project (Washington)

Friday, 9 August to Sunday, 11 August

Tour leader: Tom Hepler, U.S. Bureau of Reclamation

Price per person: US\$550 Double/\$680 Single (Includes all meals from Friday dinner through Sunday lunch)

This pre-tour features the removal of Elwha and Glines Canyon Dams, the largest dam removal project in U.S. history. Both hydroelectric dams located on the Elwha River were removed for fish passage and river restoration. Visit the scenic Olympic National Park, and enjoy the natural beauty ranging from dense forests to snowcapped mountains.

Friday, 9 August. The tour will begin with a welcome dinner at the DoubleTree Suites Seattle Airport Southcenter. Overnight at the DoubleTree.

Saturday, 10 August. Depart the DoubleTree and travel by motorcoach to Port Angeles, Washington, via the Tacoma Narrows Bridge. Following an indoor presentation on the project by U.S. Bureau of Reclamation engineers and lunch, the tour will visit the Elwha Dam site and former Lake Aldwell, followed by a tour of the Glines Canyon Dam site and former Lake Mills, with scenic stops along the Elwha River. Dinner and overnight in Port Angeles at the Red Lion Inn.

Sunday, 11 August. Depart Red Lion Inn and travel to the Elwha Surface Water Intake and Water Treatment Plant on the lower Elwha River, constructed to handle the sediment released from the dams. Next, travel to Hurricane Ridge within the Olympic National Park, with lunch at the Visitor Center. Enjoy the spectacular views of the Olympic Mountains and Elwha River watershed, including glaciers and landslides. The tour then moves to the famous 9-km-long Dungeness Spit and Lighthouse near Sequim, Washington. As you travel east back to Seattle, enjoy a brief stop at the 7 Cedars Casino before boarding a ferry boat for a ride across Puget Sound to Seattle. The tour will end at the downtown Seattle Sheraton Hotel by 19:00.

Arrival and Departure Information:

Your flight should arrive at Seattle-Tacoma International Airport (SEA) by 16:00 on 9 August. Take a taxi or a hotel shuttle van to the DoubleTree Suites Seattle Airport Southcenter. A welcome dinner will be held at the DoubleTree Suites from 19:00 to 21:00. The tour will end on Sunday at the Seattle Sheraton Hotel, the ICOLD 2013 venue. You must make your own reservations at the Sheraton Hotel, beginning on Sunday, 11 August, or make other lodging arrangements in Seattle.

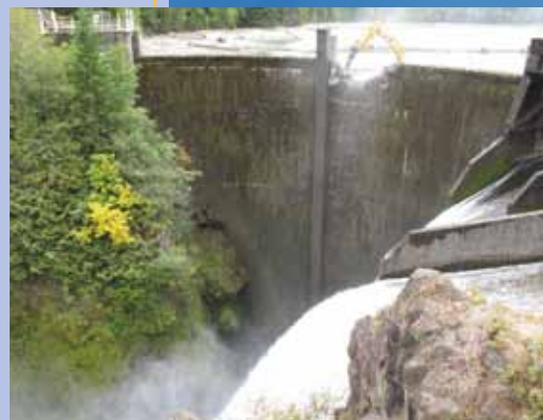
Study Tour Dams:

Elwha Dam, a 33-meter-high concrete gravity dam completed in 1913. Removal began in September 2011 and by late spring 2012, the dam was completely gone.

Glines Canyon Dam, built in 1927, was a 64-meter-high concrete arch dam. It is expected to be removed from the river by the summer of 2013, with the original gated spillway and thrust block structures remaining on both abutments to accommodate visitors to the site.



Olympic National Park



Glines Canyon Dam

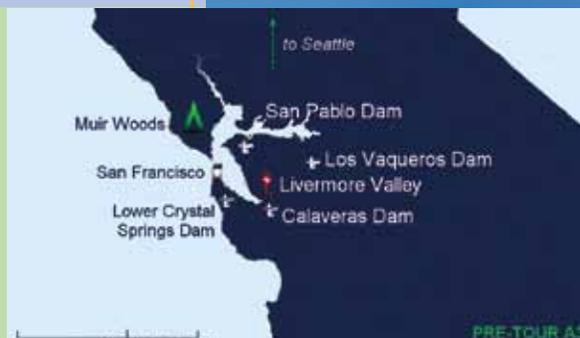
Pre-Tour A3 — San Francisco Bay Area Dams (California)

Wednesday, 7 August to Saturday, 10 August

Tour leader: Dan Wade, San Francisco Public Utilities Commission

Price per person: US\$1100 Double/\$1530 Single (Includes all meals from Wednesday dinner through Saturday lunch, except breakfasts.)

The tour features a number of major dams in the San Francisco area. Learn about recent and ongoing construction projects to upgrade the dams to meet current seismic design standards and provide anticipated water demands. Visit San Francisco



Bay Area scenic and historical sites, including the Golden Gate Bridge, the Muir Woods National Monument, and a local winery. Stay all three nights at the historic Westin St. Francis Hotel, located in the heart of San Francisco, on Union Square and surrounded by world class-shopping and restaurants, with a cable car stop outside the front door!

Wednesday, 7 August. The tour will begin at 19:00 with a welcome dinner at the Westin St. Francis Hotel in San Francisco. Overnight at the Westin St. Francis.

Thursday, 8 August. Travel by motorcoach to Calaveras Dam to observe construction of the Calaveras Dam Replacement Project. Following the dam visit and lunch in a local restaurant, travel to Los Vaqueros Dam and tour the dam. Enjoy winetasting and dinner at McGrail Vineyards and Winery, a beautiful boutique winery located in the Livermore Valley Wine Country. Return to San Francisco, overnight at the Westin St. Francis Hotel.

Friday, 9 August. Following a morning visit to San Pablo Dam, the tour will go to the Muir Woods National Monument, home to old-growth Coastal Redwoods, the tallest living trees in the world. Enjoy a box lunch and walk through the majestic groves. Stop at the famous Golden Gate Bridge on the return to San Francisco. Enjoy dinner at a landmark restaurant on the waterfront. Overnight at the Westin St. Francis Hotel.

Saturday, 10 August. A guided city tour by motorcoach will feature famous San Francisco attractions, such as Chinatown, Nob Hill, Lombard Street, cable cars and Fisherman's Wharf/Pier 39. Tour Lower Crystal Springs Dam. Following a box lunch, the tour will travel to San Francisco International Airport. Tour ends at SFO.

Arrival and Departure Information:

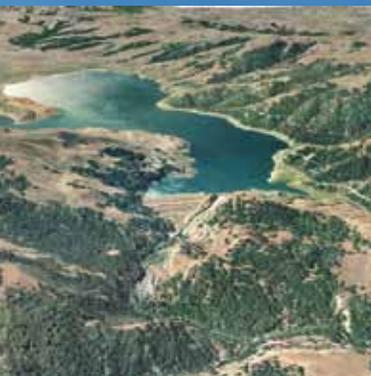
Your flight should arrive at San Francisco International Airport (SFO) by 16:00 on Wednesday, 7 August. You may take a taxi or a hotel shuttle van to the Westin St. Francis Hotel in downtown San Francisco. A welcome dinner will be held at the Westin St. Francis from 19:00 to 21:00. You must make your own flight arrangements from San Francisco International Airport to Seattle-Tacoma International Airport (SEA) after 16:00 on Saturday, 10 August. You must make your own reservations at the Seattle Sheraton Hotel beginning 10 August, or make other lodging arrangements in Seattle.

Study Tour Dams:

Calaveras Dam Replacement Project. The existing Calaveras Dam was the largest earth and rock fill dam in the world at the time of completion in 1925. The existing dam will be replaced with a new earth and rock fill embankment dam, spillway and inlet/outlet works that will accommodate a public water supply reservoir of the same size as the original and will meet current seismic safety design requirements. The project also includes fish passage and other environmental enhancements. Construction of the one-half billion dollar project began in Fall 2011 and is scheduled for completion in Fall 2015.

Los Vaqueros Dam. The original Los Vaqueros Dam, an embankment dam, was constructed in the late 1990s to provide a reservoir with a capacity of 123,348,185 cubic meters. Construction for the Los Vaqueros Reservoir Expansion Project was completed in 2012, raising the height of the dam by 10 meters and increasing storage by 60%. This additional water storage ensures the customers of Contra Costa Water District are provided with high-quality water, greater drought storage, and provides enhanced protections for Delta fisheries and the environment.

San Pablo Dam. Originally constructed in 1920, San Pablo Dam supplies water to about 1.3 million people and is a key component of the San Francisco Bay area's water supply. In addition to water supply, the dam provides flood control benefits and offers recreation opportunities such as fishing, boating, picnicking, nature study, horse riding, and hiking. A seismic upgrade construction was completed in January 2010. The in-place improvement technique chosen to improve the potentially liquefiable alluvium was a cement deep soil mixing (CDSM) technology. This was the largest application of the CDSM technology for embankment dams in the United States.



Calaveras Dam



Los Vaqueros Dam

Lower Crystal Springs Dam. Crystal Springs Dam is a concrete gravity dam constructed across the San Mateo Creek. The structure was completed in 1888 adjacent to the San Andreas Fault, and has survived numerous historic earthquakes, including both the Great 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake. The dam recently underwent hydraulic improvements, including modifications to the spillway in conjunction with raising the parapet wall on top of the dam, and constructing a new and larger stilling basin at the base of the dam.

Post-Tour B1 — Mid- and Upper- Columbia River Hydro Projects (Washington)

Saturday, 17 August to
Monday, 19 August

Tour leader: Bill Christman, Chelan County Public Utility District

Price per person: US\$900 Double/\$1165 Single (Includes all meals from Saturday lunch through Monday dinner, except Sunday dinner)



The tour features spectacular geology and changing landscapes as you travel up the Columbia River through high desert and basalt cliffs, past vibrant orchard and vineyards into the high alpine splendor of the North Cascades Mountains. Much of the electrical power for the northwestern United States is produced at dams featured on the tour, including Wanapum, Rocky Reach and Wells Dams, plus the U.S. Bureau of Reclamation's Grand Coulee Dam and Seattle City Light's Diablo Dam. Enjoy two nights in the internationally acclaimed Sun Mountain Lodge, luxury mountaintop lodging with gorgeous mountain and valley views. Enjoy some of the Northwest's finest wines at area vineyards.

Saturday, 17 August. Depart Seattle and drive over the Cascade Mountains to Wanapum Dam. Enjoy lunch at a local winery, then travel to Rocky Reach Dam. Drink in the views as you dine at Sun Mountain Lodge, your overnight destination.

Sunday, 18 August. Travel to Wells Dam and tour the dam and Hydrocombine. Travel to the world famous Grand Coulee Dam and tour the dam following lunch. Before returning to Sun Mountain Lodge, enjoy dinner on your own in the town of Winthrop, where you'll think you've traveled back in time to the wild, wild west! Overnight at Sun Mountain Lodge.

Monday, 19 August. Experience the majestic beauty of the North Cascades National Park, highlighted by a visit to the North Cascades Environmental Learning Center, on the shores of Diablo Lake. Seattle City Light officials will tell you about the Skagit River Hydroelectric Project, which provide electric power for the Seattle and surrounding communities. Following lunch in the North Cascades Institute dining hall, you will tour Diablo Dam and Powerhouse. Continuing west toward Seattle, you will visit to Challenger Ridge Vineyard & Cellars, nestled in the foothills of North Cascade Mountain Range. Taste the winery's popular Pinot Noir wines and enjoy a dinner on the lovely property before returning to Seattle and your final destination, the DoubleTree Suites Seattle Airport Southcenter. This hotel, is very near Seattle-Tacoma International Airport, making it convenient for outgoing flights on Tuesday, 20 August.

Arrival and Departure Information:

The tour will begin at the Seattle Sheraton Hotel on Saturday morning, 17 August. At the end of the tour, outgoing flights from Seattle-Tacoma International Airport (SEA) can be scheduled beginning Tuesday morning, 20 August.

Study Tour Dams:

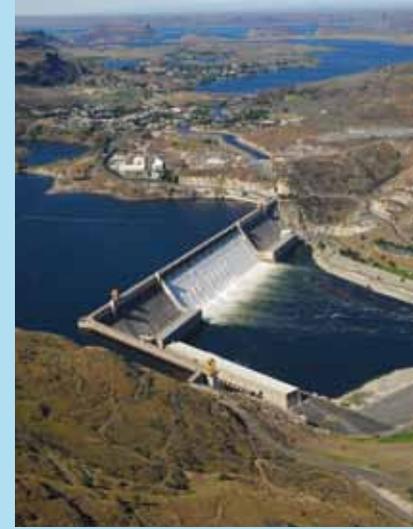
Wanapum Dam was built on the Columbia River in the late 1950s and '60s as part of the two-dam Priest Rapids Project. A new, 44-year federal license to operate the two dams was issued in 2008. Over the course of the next two decades, crews will install new, state-of-the-art turbines and new generators at each facility. The recently completed downstream-fish bypass provides an opportunity for salmon smolts to bypass the turbines. The dam is 254 meters long and 56 meters high from the deepest excavation point.

Rocky Reach Dam. Rocky Reach delivered its first power in 1961. Four additional units were added to the powerhouse in 1971 and it received a new 43-year federal license in 2009. Modernizing work on the 11 turbines and generators was completed in 2007. Its unique juvenile fish bypass system was completed in 2003.

Wells Project. This unique design combines 10 generating units, spillways, switchyard and fish passage facilities into a single structure referred to as the hydrocombine. The hydrocombine structure is 350 in length and the dam is 1,359 meters long overall.

Grand Coulee Dam. Owned and operated by the U.S. Bureau of Reclamation, the dam is one of the largest concrete structures in the world and the largest hydropower producer in the United States, generating more than 21 billion kilowatt-hours of electricity each year. The concrete gravity arch dam is 1,592 meters long. Its purposes include flood control and river regulation, water storage and delivery (including irrigation), power generation, recreation, and fish and wildlife.

Diablo Dam. Construction began in 1927, and was completed in 1930. At that time it was the tallest dam in the world at 119 meters.



Grand Coulee Dam



Post-Tour B2 — Lower Columbia River Dams and Mount St. Helens (Washington and Oregon)

Saturday, 17 August to Monday, 19 August

Tour Leader: Carolyn Flaherty, U.S. Army Corps of Engineers, Portland District

Price per person: US\$1000 Double/\$1265 Single (Includes all meals from Saturday lunch through Monday dinner)

Visit Mount St. Helens, most famous for its catastrophic eruption in May 1980, which was the deadliest and most economically destructive volcanic event in the history of the United States. Tour Bonneville Dam and The Dalles Dam on the scenic Columbia River, both important to the Pacific Northwest for power generation and navigation. At both dam projects, there have been many features added, and changes in operations, to facilitate fish passage in the region. Visit Portland, Oregon, known for its many rose gardens and microbreweries.

Saturday, 17 August. Depart Seattle and travel south to Mount St. Helens. Learn about the U.S. Army Corps of Engineers' Sediment Retention Structure and enjoy lunch at the Hoffstadt Bluffs Visitor Center, where you'll have time to enjoy the exhibits, including Memories of a Lost Landscape, which tells the story what life was like at Mount St. Helens before the blast. Following a visit to the Johnston Ridge Observatory, which brings visitors within eight kilometers of the north side of the volcano and offers spectacular views of the still-steaming lava dome, crater, pumice plain and landslide deposit. Enjoy the views as you dine at Skamania Lodge, a magnificent mountain resort on the Washington side of the Columbia River, your overnight destination.



Mount St. Helens



The Dalles Dam

Sunday, 18 August. Travel to The Dalles Dam and Visitor Center on the Columbia River. Following lunch at a riverside restaurant, tour Bonneville Dam Visitor Center and fish hatchery. Experience the power and beauty of Multnomah Falls, a 186-meter cascade of icy water. Travel to Portland, where you'll enjoy dinner at a local landmark restaurant. Overnight at the Portland Embassy Suites.

Monday, 19 August. Following a city tour featuring Portland attractions such as Pioneer Square, Portland's world famous Rose Gardens, and historic neighborhoods and parks, you will enjoy breathtaking scenery and freshly prepared Northwest cuisine during a lunch cruise on the Willamette River. Travel to Seattle and a farewell dinner at your final destination, the DoubleTree Suites Seattle Airport Southcenter. This hotel is very near Seattle-Tacoma International Airport, making it convenient for outgoing flights on Tuesday, 20 August.

Arrival and Departure Information:

The tour will begin at the Seattle Sheraton Hotel on Saturday morning, 17 August. At the end of the tour, outgoing flights from Seattle-Tacoma International Airport (SEA) can be scheduled beginning Tuesday morning, 20 August.

Study Tour Projects:

Mount St. Helens. Fifty-seven people were killed; 250 homes, 47 bridges, 24 kilometers of railways, and 298 kilometers of highway were destroyed. A massive debris avalanche triggered by an earthquake measuring 5.1 on the Richter scale caused an eruption, reducing the elevation of the mountain's summit from 2,950 meters to 2,550 meters, replacing it with a 1.6 kilometer-wide horseshoe-shaped crater. The **Sediment Retention Structure** is a 550-meter-long, 56-meter-high earthen dam on the North Fork of the Toutle River. It was completed by the U.S. Army Corps of Engineers in 1989 to retain sediment created since the 1980 eruption, to prevent the sediment from becoming a hazard to river navigation. The spillway crest was raised in 2012..

The Dalles Dam. The Dalles Dam consists of a navigation lock, 23-bay spillway, 22-generator powerhouse and fish passage facilities, spanning the Columbia River 75 kilometers above Bonneville Dam and near the city of The Dalles, Oregon. The Dalles Dam was completed in 1957. The dam was built and is managed by the U.S. Army Corps of Engineers.

Bonneville Dam. Bonneville Dam consists of several run-of-the-river dam structures that together complete a span of the Columbia River, 64 kilometers east of Portland, Oregon. The first powerhouse, spillway, and original navigation lock were completed in 1938 to improve navigation on the Columbia River and provide hydropower to the Pacific Northwest. A second powerhouse was completed in 1981, and a larger navigation lock in 1993. Portions of Bonneville Lock and Dam Project were declared a National Historic Landmark in 1987. The primary functions of Bonneville Lock and Dam are electrical power generation and river navigation. The dam was built and is managed by the U.S. Army Corps of Engineers.



Bonneville Lock and Dam

Post-Tour B3 — Northern California Dams (California)

**Saturday, 17 August to
Wednesday, 21 August**

Tour leader, Gary Egan, Retired, HDR Engineering, Inc., and U.S. Bureau of Reclamation

**Price per person: US\$825 Double/\$1100 Single
(Includes all meals from Saturday dinner through
Wednesday lunch, except Monday dinner)**

Visit Northern California's most important dams, which supply water to millions of people in the nation's most populous state, and irrigation water for millions of hectares of agricultural land. Enjoy Sacramento, California's historic capital city. Final destination: the spectacular city of San Francisco!



Saturday, 17 August. Fly from Seattle-Tacoma International Airport to Sacramento on your own. Your flight should arrive in Sacramento no later than 13:00. From the Sacramento Airport, you will board a motorcoach at 14:00 and travel to Folsom Dam. Following a presentation and a dam tour, travel to downtown Sacramento and enjoy a welcome dinner in the Sheraton Sacramento Hotel, your overnight destination.

Sunday, 18 August. Travel to Redding and tour Shasta Dam. Visit the Sundial Bridge, which crosses the Sacramento River in the heart of Redding. The steel, glass, and granite span evokes a sense of weightlessness, and in addition to being a functional work of art, the Sundial Bridge is a technical marvel. Enjoy the gorgeous display gardens and water features at the nearby McConnell Arboretum and Botanical Gardens. Overnight at the Oxford Suites Hotel in Redding.

Monday, 19 August. Travel to Oroville Dam. Following a tour of the dam and fish hatchery, enjoy lunch in nearby Chico. Upon arrival in Sacramento, visit Old Sacramento, the historic heart of the city, home to shopping, dining, entertainment, historical attractions and world-renowned museums set within the time of the California Gold Rush and the Transcontinental Railroad. Dine on your own in one of the many restaurants in this historic district. Overnight at the Sheraton Sacramento Hotel.

Tuesday, 20 August. Travel to nearby Davis and tour the University of California, Davis Laboratory. Following lunch, tour the Hydraulic Engineering Center, a U.S. Army Corps of Engineers facility for technical research and training in hydrologic engineering and water resources planning and management. Return to Sacramento and enjoy free time for shopping and sightseeing before the farewell dinner on the historic Delta King Riverboat. Overnight the Sheraton Sacramento Hotel

Wednesday, 21 August. Travel west through the famous Napa Valley wine country to Monticello Dam. Following a tour of the dam, enjoy lunch at a nearby winery. Travel to San Francisco International Airport. Tour ends at SFO.

Arrival and Departure Information:

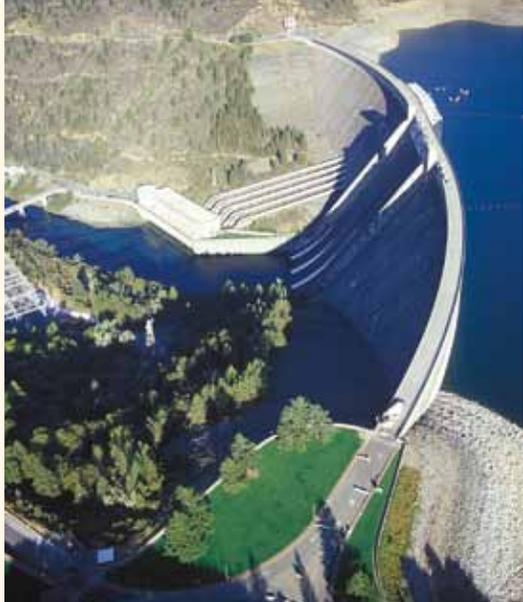
Fly from Seattle-Tacoma International Airport (SEA) to Sacramento (SMF) on your own. Your flight should arrive in Sacramento no later than 13:00 on Saturday, 17 August. At the end of the tour, outgoing flights can be scheduled from San Francisco (SFO) no sooner than 16:00 on Wednesday, 21 August.

Study Tour Projects:

Folsom Dam. Folsom Dam was built by the U.S. Army Corps of Engineers from 1948 to 1955 and is operated by the U.S. Bureau of Reclamation. It is a key feature of the Central



Folsom Dam



Shasta Dam

Valley Project, a system of dams, reservoirs, canals and power plants that provides hydroelectricity, drinking water and water for irrigation and other uses. The dam has a 106-meter-high concrete center section with earthen wing dams for a total length of 427 meters. A new spillway is under construction at the left abutment and is scheduled for completion in 2015. The project will help the Sacramento region achieve a 200-year level of flood protection.

Shasta Dam. Shasta Dam is a concrete gravity arch dam owned and operated by the USBR. The dam is 183 meters high and 1,036 meters long. The dam was constructed in 1938 to 1945. Studies are underway to raise height of the dam and increase the storage.

Oroville Dam. The tallest dam in the U.S., at 234 meters high, the zoned earthfill embankment dam is 2,109 meters long. The dam is owned and operated by the California Department of Water Resources and was built in 1961 to 1968.

University of California, Davis Laboratory. For more than 40 years, engineers have been conducting hydraulic investigations through scaled and prototype models to provide modeling service to the state and local water agencies of California. The laboratory has both open space and indoor space for physical hydraulic experiments.

Hydraulic Engineering Center. The HEC is the designated Center of Expertise for the U.S. Army Corps of Engineers in the technical areas of surface and groundwater hydrology, river hydraulics and sediment transport, hydrologic statistics and risk analysis, reservoir system analysis, planning analysis, real-time water control management and a number of other closely associated technical subjects.

Monticello Dam. The dam is a concrete, medium-thick arch structure with a height of 93 meters above the foundation and a crest length of 312 meters. Constructed between 1953 and 1957, it is a medium concrete-arch. The dam forms Lake Berryessa and water from the reservoir primarily supplies agriculture in surrounding areas. The dam is noted for its classic, uncontrolled morning-glory type spillway. The Monticello Dam Powerplant was built at the dam in 1983 and has three generators.

Post-Tour B4 — Southeastern U.S. Dams with Alkali-Aggregate Reactions and International Workshop (Georgia, Tennessee and North Carolina)

Saturday, 17 August to Wednesday, 21 August

Tour Leader: Robin Charlwood, Robin Charlwood and Associates, and Chairman of the ICOLD Committee on Concrete Dams

Price per person: US\$900 Double/\$1130 Single (Includes all meals from Sunday breakfast through Wednesday lunch)

Visit four major dams in Tennessee and North Carolina and participate in a one-day International Workshop on current practices for the management of AAR-affected



dams. Learn about the recent and ongoing investigations and rehabilitation projects to maintain safe operation of these important facilities to meet current design standards and regulatory requirements and continue safe operation into the future. The tour also includes a visit to Chattanooga, Tennessee, and travels through the beautiful Great Smokey Mountains. Overnight accommodations and the Workshop will be held at the beautiful Fontana Village Resort, where there are many recreational opportunities for the delegates and accompanying persons.

Saturday, 17 August. Fly from Seattle-Tacoma International Airport to Hartsfield–Jackson Atlanta International Airport on your own. Take a hotel shuttle van or taxi to the nearby Hyatt Place Atlanta Airport North, your overnight destination. Welcome reception at the hotel at 20:30.

Sunday, 18 August. Travel by motorcoach to Chickamauga Lock and Dam to view lock replacement construction project. Following lunch at the famed Chattanooga Choo Choo Railcar Restaurant, travel to Fontana Village Resort, your overnight destination. This lovely resort in the Great Smokey Mountains was developed from the construction village when Fontana Dam was built and will be your home for three nights.

Monday, 19 August. Travel to nearby Fontana Dam for presentations and tour of the AAR-affected dam. Following a brief visit to the Fontana Emergency Spillway and lunch, travel to Santeetlah Dam for a tour and presentations on the active maintenance works and investigations that has allowed continued operation of the dam despite severe surface deterioration. Return to Fontana Village for relaxation and a fun outdoor BBQ dinner.

Tuesday, 20 August. Remain at Fontana Village for the International Workshop on Managing AAR in Dams. (see Workshop agenda below). Following the Workshop, enjoy a social hour and farewell dinner at the resort.

Wednesday, 21 August. Travel to Hiwassee Dam for presentations and a tour. Following lunch, travel to Atlanta International Airport, where the tour ends at 16:00. Participants needing Wednesday evening lodging will be transported to the Hyatt Place Atlanta Airport North (lodging not included in tour price)

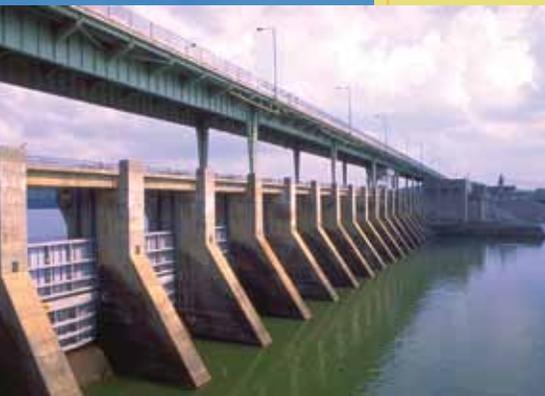
Arrival and Departure Information:

Delegates must make own arrangements to fly from Seattle-Tacoma International Airport (SEA) to Hartsfield–Jackson Atlanta International Airport (ATL) on Saturday, 17 August, arriving in Atlanta by 19:00 if possible. At the end of the tour, departing flights should be scheduled to depart the Atlanta Airport no sooner than 18:00 on Wednesday, 20 August.

Study Tour Projects:

Chickamauga Lock and Dam. The project is owned by Tennessee Valley Authority; TVA operates the dam and the lock is operated by the U.S. Army Corps of Engineers. The dam on the Tennessee River was built in the late 1930s to improve navigation and bring flood control and economic development to the Tennessee Valley. Chickamauga Dam is a concrete gravity-type dam 1,800 meters long and 39 meters high, with a generating capacity of 160 megawatts. The dam has 18 spillway bays with a combined discharge of 13,000 cubic meters per second. A major lock replacement project is in the early stages of construction, with ongoing maintenance of the existing lock and spillways to allow continued operation.

Fontana Dam. This 146-meter-high gravity dam was completed in 1946. Cracking developed in the late 1960s at the location of the curvature near the spillway, and an overlapping slot was installed in 1970. Subsequently, various investigations were performed, extensive instrumentation was installed, post-tensioned anchors were installed both vertically from the deck and inclined in the crack area, and based on detailed modeling an ongoing program of diamond wire saw cuts and automated instrumentation is being used to maintain the structure. The Fontana Emergency Spillway is no longer in service, but is an interesting example of a small arch dam that has survived more than 25-centimeter upstream movement of the crest without failure.



Chickamauga Lock and Dam

Santeetlah Dam. This thin arch dam was built in 1928, and extensive modifications were made soon after initial construction. AAR was identified in the early 1940s, and the first known use of overlapping drill hole slots was employed here in 1942. Since then, an active program of investigations and maintenance has allowed continued operation of the dam despite severe surface deterioration. These include the first known use of diamond wire saw cuts in an arch dam. The project is owned by Brookfield Renewable Power.

Hiwassee Dam. Hiwassee Dam is a concrete gravity overflow dam 94 meters high and 419 meters long, with a generating capacity of 185,000 kilowatts. The dam's spillway is controlled by seven radial gates, which, along with four regulating conduits at the bottom of the dam, give the dam a total maximum discharge of 3,200 cubic meters per second. TVA has had a comprehensive instrumentation and modeling program at Hiwassee Dam for many years, and has made diamond wire saw cuts at the abutments and near the large radial spillway gates to control longitudinal expansion and gate clearances. Recutting is scheduled for 2013. In addition, there is a load monitoring system for the post-tensioned trunnion anchors.

International Workshop on Managing AAR in Dams — Tentative Agenda (for a more detailed and current agenda, please go online and link to www.icold2013.org/aar.pdf).

08:00 – 10:00 — Session 1: Overview and Discussion of Dams visited on tour

- Overview
- Managing AAR at Chickamauga, Fontana and Hiwassee

10:30 – 12:00 — Session 2: Tour Dams and Other U.S. Dams

- Construction History and Managing AAR at Santeetlah Dam
- Managing AAR at Roanoke Rapids Dam
- U.S. Army Corps of Engineers Experiences
- U.S. Bureau of Reclamation Experiences

12:00 – 13:00 — Lunch at Fontana Village

13:00 – 16:00 — Session 3: International Perspectives

- Mactaquac (New Brunswick, Canada);
- Hydro Quebec Experience
- Brazilian Experience
- African Experience

16:30 – 17:30 p.m. — Session 4: International Perspectives (continued)

- French Experience
- Portuguese Experience
- Spanish Experience
- Swiss Experience

5:30 – 6:00 pm — Panel Discussion — International Panelists

- Lessons Learned for Maintaining Existing Dams
- What lies ahead?
- Prevention of AAR in New Dams

Post-Tour B5 — Southern California Dams (California)

Saturday, 17 August to Wednesday, 21 August

Tour Leader: Chris Hill, Metropolitan Water District of Southern California

Price per person: US\$1300 Double/\$1800 Single (Includes all meals from Sunday breakfast through Wednesday lunch)

Visit some of the newest dams in the United States and learn about advances in technologies for seismic robustness, instrumentation, roller compacted concrete, enhancements of existing infrastructure, interagency cooperation, and the evolution of water supply and flood control in arid southern California. Enjoy San Diego's many attractions. Tour ends in Los Angeles.

Saturday, 17 August. Fly from Seattle-Tacoma International Airport to San Diego on your own. Motorcoach transportation will transport you from the airport to the San Diego Sheraton Hotel. In the evening, a motorcoach will take you to Old Town, where you will be on your own to experience the history and culture of San Diego. In this walking district, you'll find many restaurants, shops and historic sites. Overnight at the San Diego Sheraton.



Sunday, 18 August. Enjoy a guided motorcoach tour of San Diego attractions, including sparkling Coronado, the historic Gaslamp Quarter, and the resplendent and beautiful Balboa Park. Enjoy visiting La Jolla, home to various natural sea caves and its sea coast. The day will culminate with a special dinner at a landmark attraction in San Diego.

Monday, 19 August. Travel to San Vicente Dam and learn about the tallest enlargement of an existing dam in the U.S. and the tallest raise using RCC in the world. Following a tour of the dam and lunch, tour Olivenhain Dam, an RCC dam providing water supply reliability to southern California. Travel to the north coast and the Carlsbad Inn, your overnight destination.

Tuesday, 20 August. Travel to Diamond Valley Lake, impounded by three earthen dams. Following a tour of the project, enjoy lunch in a nearby Temecula Valley winery. Next, visit the Carlsbad Desalination Project, that upon completion, will produce enough water to meet about seven percent of the region's water needs in 2020. Farewell dinner in a spectacular north coast setting. Overnight in Carlsbad Inn.

Wednesday, 21 August. Travel to Seven Oaks Dam, the 10th largest earthfill dam in the U. S. Following a tour of the dam, and lunch, travel to Big Tujunga Dam to learn about the recent seismic upgrade project. Travel to Los Angeles. Tour ends at the LAX Westin Hotel, where you may enjoy dinner on your own.

Arrival and Departure Information:

Fly from Seattle-Tacoma International Airport (SEA) to San Diego International Airport (SAN) on your own on Saturday, 17 August. At the end of the tour, flights should be scheduled to depart LAX on Thursday, 22 August.



San Vicente Dam

Study Tour Projects:

San Vicente Dam. The original San Vicente Dam was completed in 1943. It was a 67-meter-high conventional concrete gravity dam with a crest length of 300 meters. The San Vicente Dam Raise is part of the Emergency Storage Project, a system of reservoirs, interconnected pipelines, and pumping stations designed to make water available to the San Diego region in the event of an interruption in imported water deliveries. The 36-meter dam raise more than doubles the capacity of the reservoir. The dam raise is being accomplished by constructing a roller compacted concrete dam over the existing dam. Construction began in 2009 and is projected to be complete by early 2013. The San Vicente Dam raise will be the tallest enlargement of an existing dam in the United States and the tallest raise using RCC in the world.

Olivenhain Dam. The purpose of Olivenhain Reservoir is water supply reliability, particularly following an earthquake that would sever aqueducts bringing water into the San Diego region. Olivenhain Dam has a crest length of 778 meters and a height of 97 meters. It is the largest RCC dam in the U.S. and the first large RCC dam permitted in seismically active southern California. Several innovations for the design, placement and testing of RCC were developed during its design and construction. World records for one day- and 30- day placement of RCC were set during its construction.

Diamond Valley Lake. Diamond Valley Lake is an off-stream storage reservoir for water supply reliability, particularly if major aqueducts are damaged by earthquakes. Three dams form the reservoir. Construction of the dams was completed in 1999 at a total cost of about US\$1.9 billion. The project was the largest earth moving project in the U.S. and involved some of the largest earthmoving equipment ever used for a construction project. The dams are comprehensively instrumented with an automated data acquisition system for seepage and piezometer data and an automated theodolite system for deformation measurements.

Carlsbad Desalination Project. The seawater desalination plant will produce enough water to meet about seven percent of the region's water needs in 2020, reducing San Diego's dependence on imported water and significantly improving water reliability in the region. The Carlsbad Desalination Project will provide San Diego County with a locally-controlled, drought-

proof supply of high-quality water that meets or exceeds all state and federal drinking water standards. After ten years of planning and six years in the state's permitting process, the Carlsbad Desalination Plant has now received final approvals from every required regulatory and permitting agency in the state and construction will begin in early 2013.

Big Tujunga Dam. Big Tujunga Dam is a concrete arch completed in 1931 and serves mainly for flood control. In 1976, the dam was recognized as in danger of failure from earthquakes and the reservoir's level was restricted to about 25% of capacity. The retrofit involved adding approximately 57,000 cubic meters of concrete to the dam, transforming it from a thin-arch to a thick-arch design. A new spillway was built and the original one was expanded. The seismic retrofit project was completed in July 2011 at a cost of US\$100 million.

Post-Tour B6 — Colorado River and the Grand Canyon (Nevada and Arizona)

Saturday, 17 August to
Wednesday, 21 August

**Tour leader: Bob Johnson, Water
Consultant and former Commissioner,
U.S. Bureau of Reclamation**

Price per person: US\$975

**Double/\$1260 Single (Includes all
meals from Sunday lunch through
Wednesday dinner)**



Visit iconic dams along the Colorado River in the southwestern United States. Learn about the historical and current role of the Colorado River and its dams in the population growth and economic development in the western states. Visit one of the world's greatest wonders — the Grand Canyon.

Saturday, 17 August. Fly from Seattle-Tacoma International Airport to Las Vegas, Nevada, on your own. Take a shuttle van or taxi to the nearby Renaissance Hotel, your overnight destination. A welcome reception will be held at the hotel at 18:00, allowing you plenty of time before and after the reception to enjoy Las Vegas.

Sunday, 18 August. Travel by motorcoach to the famous Hoover Dam for a special VIP tour of the dam. Following lunch at the Visitor Center, travel to the Grand Canyon. Enjoy dinner at the Best Western Grand Canyon Squire Inn, your overnight destination.

Monday, 19 August. Tour the spectacular South Rim of the Grand Canyon. This UNESCO World Heritage Site is 446 river kilometers long, up to 29 kilometers, and 1.6 kilometers deep. After experiencing the wonder and beauty of the Grand Canyon, travel to Page, Arizona, for a tour of Glen Canyon Dam, the second largest dam on the Colorado River. Travel to beautiful Flagstaff, Arizona, set in the mountains of northern Arizona. Overnight at the Flagstaff Embassy Suites.

Tuesday, 20 August. Travel south through central Arizona to New Waddell Dam. Following a lakeside lunch, tour New Waddell Dam, then travel on to Scottsdale, Arizona, a suburb of Phoenix. Enjoy a special BBQ at the home of your tour leader. Overnight at the Chaparral Suites in Scottsdale.



Grand Canyon



New Waddell Dam

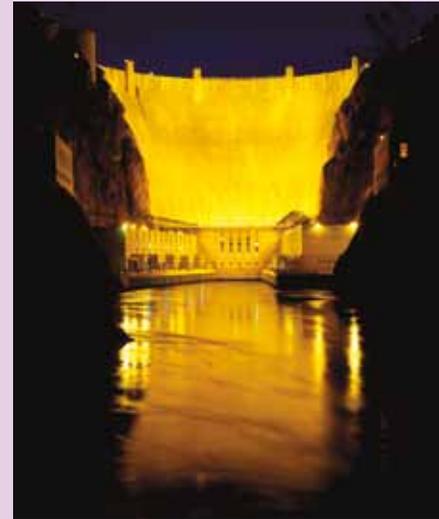
Wednesday, 21 August. Travel to Theodore Roosevelt Dam and tour this historic and recently modified dam on the Salt River northeast of Phoenix. Return to Scottsdale and enjoy a farewell dinner in this picturesque desert community.

Arrival and Departure Information:

Fly from Seattle-Tacoma International Airport (SEA) to Las Vegas, Nevada (LAS), on your own on Saturday, 17 August. Your flight should arrive by 16:00 hours. At the end of the tour, flights should be scheduled to depart Phoenix Sky Harbor International Airport on Thursday, 22 August.

Study Tour Projects:

Hoover Dam. Hoover Dam, once known as Boulder Dam, is a concrete arch-gravity dam on the border between the Arizona and Nevada. Built by the U.S. Bureau of Reclamation between 1931 and 1936, its construction was the result of a massive effort involving thousands of workers. The dam was constructed during the Great Depression and became a symbol of economic hope. Many innovative processes and techniques related to concrete technology, valves and hydraulic equipment were developed during its design and construction. The dam provides hydroelectric power, irrigation and municipal water supply, flood control and recreation. An impressive new bridge just downstream of the dam was completed in 2010. The bridge is 271 meters above the river, the second highest bridge in the world.



Hoover Dam

Glen Canyon Dam. This dam is the key feature of the U.S. Bureau of Reclamation's Colorado River Storage Project. The 216-meter-high concrete arch dam has a crest length of 475 meters. A separate spillway is constructed in each abutment, consisting of an intake structure with two radial gates and a lined spillway tunnel. The downstream portions of the spillway tunnel were used during construction as diversion tunnels. The powerplant at the toe of the dam consists of four 118,750-kilowatt and four 136,562-kilowatt generators driven by eight turbines. Total nameplate generating capacity for the powerplant is 1,021,248 kilowatts. Eight penstocks through the dam convey water to the turbines.

Central Arizona Project. The CAP is a 541-kilometer-long system of aqueducts, tunnels, pumping plants and pipelines, and is the largest single resource of renewable water supplies in the state of Arizona. It provides municipal water to the cities such as Phoenix, Mesa, and Scottsdale, agricultural water to irrigation districts and supplies water to several Indian communities.

New Waddell Dam. Construction was completed on New Waddell Dam in 1994, replacing the original dam built in 1927 and increasing storage capacity by almost ten-fold. The dam is a zoned earthfill embankment dam with a height of 134 meters and a crest length of 1,430 meters. The New Waddell project includes a pump-generation project, which provides efficiency in moving water as well as hydropower revenue. Colorado River water supplied by the CAP is pumped into the reservoir during low demand/low cost winter months and flows out for irrigation, providing hydropower during high demand/high cost summer months.

Theodore Roosevelt Dam. The original Theodore Roosevelt Dam was completed in 1911, the first major structure built by the U.S. Bureau of Reclamation on the Salt River Project. The dam, located 122 kilometers northeast of Phoenix, had an original height of 85 meters, and was the highest masonry dam in the world. In 1996, a project to expand and renovate the dam was completed. This project raised the dam by 24 meters for a total height of 109 meters and resulting in a 20 percent increase in reservoir capacity. The expansion of the dam was accomplished using a concrete overlay. The cost of the expansion totaled US\$430 million and included the realignment of a highway over a new bridge, improvements to the power plant and a tunneled lake tap.

Language

During ICOLD 2013, English-French simultaneous interpretation will be provided during the General Assembly on Friday, 16 August. Other official events, including committee meetings, Symposium, Workshops, and tours will be in English.

Letters of Invitation/U.S. Visas

All ICOLD guests are responsible for their own travel arrangements, including permissions to enter the United States. If your country of residence requires a letter of invitation for travel to the United States, please send an e-mail to USSD at <registration@ICOLD2013reg.org>. Letters will be sent to the main registrant with all accompanying person names included. USSD will only send letters of invitation to those who are registered for the meeting. Registrants are responsible for all costs associated with attending the meeting and visa application. If you require a visa to enter the United States, we strongly recommend you begin this process as soon as possible to allow adequate time for registration and visa processing as this process sometimes takes several months or longer. Find detailed information on U.S. visa requirements at <http://travel.state.gov>. To aid in this process, USSD has registered the ICOLD 2013 meeting with the U.S. Department of State (through the National Academy of Sciences), and information about ICOLD 2013 has been sent to U.S. consular offices worldwide.

VISA Waiver program: Effective 20 January 2010, all travelers from Visa Waiver Program countries must apply for travel authorization online before departure (filling out Form I-94W onboard the airplane is no longer permitted). Apply for authorization at <https://esta.cbp.dhs.gov> at least one week before your departure. An administrative fee is required and may be paid by credit card when applying for authorization.

Arrival Transportation

All travelers should plan to arrive at the Seattle-Tacoma International Airport (SEATAC), which is just 24 kilometers south of downtown Seattle. SEATAC is served by 25 airlines from both domestic and international carriers. Seattle is also served by Amtrak passenger trains in a downtown terminal.

The ICOLD 2013 Registration Fee for Delegates and Accompanying Persons includes Central Link light rail (train) transportation from SEATAC to downtown Seattle. Once through customs, you will find a 10 minute walk from baggage claim to the train. The normal schedule provides a train that departs SEATAC every 7.5 to 15 minutes (depending on time of day) from 05:00 to 01:00 Monday through Saturday and 06:00 to 24:00 on Sunday. The train will make 11 stops along the way from the airport to downtown Seattle. ICOLD guests should exit at the last stop (Westlake), which is approximately two blocks from the Sheraton Seattle Hotel. Travel time is approximately 40 minutes. There is limited luggage storage space on light rail trains.

For those not wishing to use light rail, USSD will provide motorcoach transportation from SEATAC to the Sheraton Hotel for US\$25 per person. This option will be available from 08:00 to 20:00 on Saturday, 10 August through Tuesday, 13 August.

Please indicate your transportation choice on the ICOLD 2013 Registration Form. The optional transportation by motorcoach must be prepaid at the time of registration to allow scheduling. Motorcoach transportation will not be available at all times, so those wishing to use this service must indicate so on the registration form. Taxi service is also available from SEATAC directly to the hotel for an average cost of about US\$40.

From Saturday, 10 August through Wednesday, 13 August, ICOLD 2013 representatives will be available outside customs and baggage claim areas of the airport to assist passengers with transportation to the Sheraton Hotel. They will provide tickets and direct passengers to the Light Rail trains, or to the motorcoaches, if you have selected that option on your registration form. Passengers who arrive on other days may take light rail, a taxi, or shuttle service on their own.

Arrival Flight Information

ICOLD Delegates and Accompanying Persons are asked to provide airline arrival information on the Registration Form, whether choosing the free light rail option, or the motorcoach transportation option.

Departure Transportation

Transportation from the Sheraton Hotel to SEATAC must be arranged by the delegate. Options include taxi, shuttle vans and light rail. Additional information and assistance will be provided during ICOLD 2013 at the Registration Desk.

Official Air Carrier

USSD is pleased to have United Airlines as the Official Air Carrier of the ICOLD 2013 81st Annual Meeting. You may book online at www.united.com and enter "ZNKD559824" in the box marked "Offer Code" when searching for your flights for discounted rates.

If booking through a travel professional or directly through United Meetings at 800-426-1122, please give them the following information:

Agreement Code: 559824
Z Code: ZNKD

When making air arrangements outside of the United States, please call your local United Airlines Reservation Office to provide the information above.

Climate and Clothing

Summer is delightful in Seattle. Visitors will enjoy warm days, late sunsets and lush, green vegetation. The average daily maximum temperature in August is 23.3°C, and the average monthly rainfall is 2.95 cm.

You may wish to bring a light jacket and umbrella, as well as comfortable walking shoes. Business casual clothing is recommended for most ICOLD 2013 activities. The farewell dinner will be a more formal event.

Smoking Laws

The State of Washington enacted the Smoking in Public Places Act in 2005. The law prohibits smoking in all public spaces, including restaurants and bars. The law also prohibits smoking within approximately eight meters of entrances and exits of areas where smoking is prohibited.

The Sheraton Hotel is a smoke free hotel; smoking is not allowed in the sleeping rooms or public areas at any time. Similar smoking restrictions can be expected during the Study Tours.

Currency and Foreign Exchange

Currency Exchange services are offered by major banks and private companies, such as Travelex Currency Services. A Travelex office is located near the baggage claim area at the Seattle-Tacoma International Airport. A downtown office is located near the Sheraton Hotel at 400 Pine Street, Level 3. ATMs (Automated Teller Machines) are found at the airport and throughout the city, including the Sheraton Hotel. Major credit cards are widely accepted. Travelers checks are accepted less frequently.

Medical Insurance

Accidental injury/medical emergency insurance is strongly recommended and should be purchased prior to arrival in the United States. USSD and/or ICOLD are not financially responsible for any illnesses or injuries that may be incurred by participants. Please refer to the following website for reference. <http://www.medexassist.com/Individuals/Products/travmedchoice.aspx>.

Electricity

Electricity in the United States is 120 volts AC at a frequency of 60 Hz. Type A plugs are used (two flat blades).

Internet

Free in-room Wi-Fi is offered to ICOLD 2013 guests staying at the Sheraton Hotel. There are several computer terminals in the Sheraton lobby, or you may bring your laptop for complimentary wireless broadband in the lobby. Free Wi-Fi will also be offered in the Exhibition Hall Monday through Thursday, courtesy of **Worthington Products, Inc.**

Categories and Fees

ICOLD Member Countries	Registration by 1 May	US\$1,100
ICOLD Member Countries	Registration after 1 May	US\$1,200
Non-ICOLD Member Countries	Registration by 1 May	US\$1,320
Non-ICOLD Member Countries	Registration after 1 May	US\$1,440
Young professionals (age 35 and younger)	Registration by 1 May	US\$550
Young professionals (age 35 and younger)	Registration after 1 May	US\$650
Symposium Only		US\$400
Accompanying Persons	Registration by 1 May	US\$350
Accompanying Persons	Registration after 1 May	US\$400

Delegate (including Young Professional) Registration includes:

- Welcome Reception
- Seattle City Tour
- Symposium, including Proceedings
- Exhibition
- Cultural Event
- Technical Tour or Technical Workshops on Thursday
- Technical Workshops or General Assembly on Friday
- Farewell Dinner
- Lunches and coffee breaks Tuesday-Friday
- Book on U.S. Dams

Symposium only Registration includes:

- Symposium, including Proceedings
- Book on U.S. Dams
- Exhibition
- Lunch and coffee breaks on Wednesday
- Cultural Event

Accompanying Person Registration includes:

- Hospitality Room Monday-Friday
- Welcome Reception
- Seattle City Tour
- Cultural Event
- Farewell Dinner

Methods of payment. Payment for registration and tours will be accepted by credit card, international or domestic wire transfer or check. Prepayment is required.

Cancellation Policy. Cancellation requests for Pre- and Post-Study Tours must be received by 1 May. Cancellation requests for registration fees and Optional Tours must be received by 1 July 2013. No refunds will be given after these dates, but substitutions are acceptable. All registration cancellations and substitutions are subject to a US\$50 service fee. All cancellation requests must be submitted in writing to ICOLD 2013 Registration Services by e-mail (registration@icold2013reg.org) or fax (1-206-783-5594). Phone cancellations will not be accepted.

To register...

Please go to www.icold2013.org.

For a printed registration form, contact ICOLD Registration Services by e-mail (registration@icold2013reg.org) or by fax (1-206-783-5594).



www.icold2013.org