



Laser-Illuminated Cinema Projection Regulatory Update

ICTA at CineEurope - 2015

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- LIPA Co-founder and Membership Chair
- The Laser Guy – Barco





Outline

1. What is LIPA and what does it do?
2. What is a Laser Illuminated Projector - “LIP”?
3. Why are LIPs regulated?
4. Who regulates LIPs?
5. What must Exhibitors do to deploy LIPs?
6. Summary



Introduction to LIPA

Mission and Objectives
Membership



LIPA=Laser-Illuminated Projector Association

Mission: To simplify the adoption of laser illuminated projectors through cooperative industry activity

- » Safety
- » Regulatory Simplification
- » Education, metrology and best practices

Membership: Performance projection industry

- » Projector manufacturers (Cinema and non-cinema)
- » Component manufacturers (lasers, chips, screens, lenses)
- » End-Users (exhibitors, integrators, studios, theme parks)

**LIPA GOAL: Make it easier and safe to install and operate
Laser illuminated projectors = “LIPs”**

LIPA Members - 23



Please Join LIPA...!



Laser *Illuminated* Projector Systems

How LIPs are different from Lamp Projectors



Laser *ILLUMINATED* Projectors

RED GREEN and **BLUE** laser beams are **EXPANDED** to ***illuminate*** the 3 imaging chips in the projector

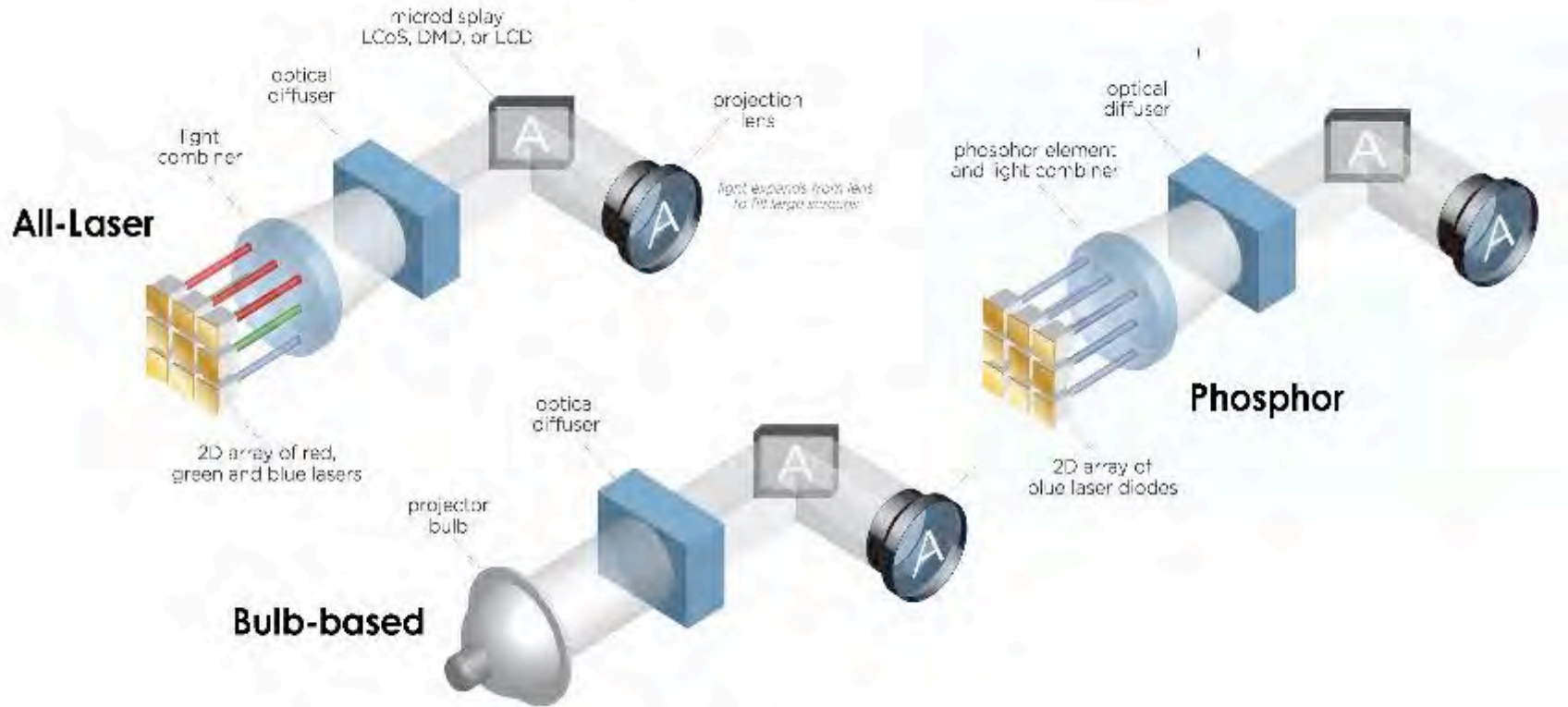
Each primary image is then recombined

and projected on the screen

Further expanding the beam

But no high power laser beams come out of the projector

Laser Illumination Architectures



Why LIPs are REGULATED

Past regulation logic

LIPA Proposes new risk definition



Why are Laser Projectors Regulated?

- In the 1970s, Laser Light Shows (LLS) came on the scene.
- These Laser Light Shows used **dangerous, high power, “collimated” laser beams** that rapidly scanned the venue
- Direct exposure to **high RADIANCE laser beams** could cause eye damage
- **First US FDA**, then other agencies, regulated Laser Light Shows
- 40 years later, Laser ILLUMINATED Projectors (LIPs) arrived

BUT THEY ARE MORE LIKE LAMP PROJECTORS THAN LASER SHOWS

LIP Regulatory Terminology

- Brightness [lumens] (photometric)
- Throw Ratio
- Angular subtense α [Rad]
- Radiance L [W/m²sr] (radiometric)
≈ effect on the human eye
- **IEC 60825-1:2014** laser safety standard
- **IEC 62471:2006** lamp (broadband) safety standard
- **IEC 62471-5:2015** (Final Draft stage) image projector safety standard

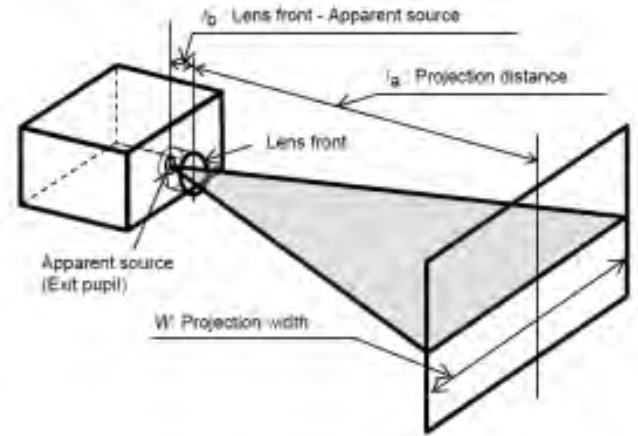
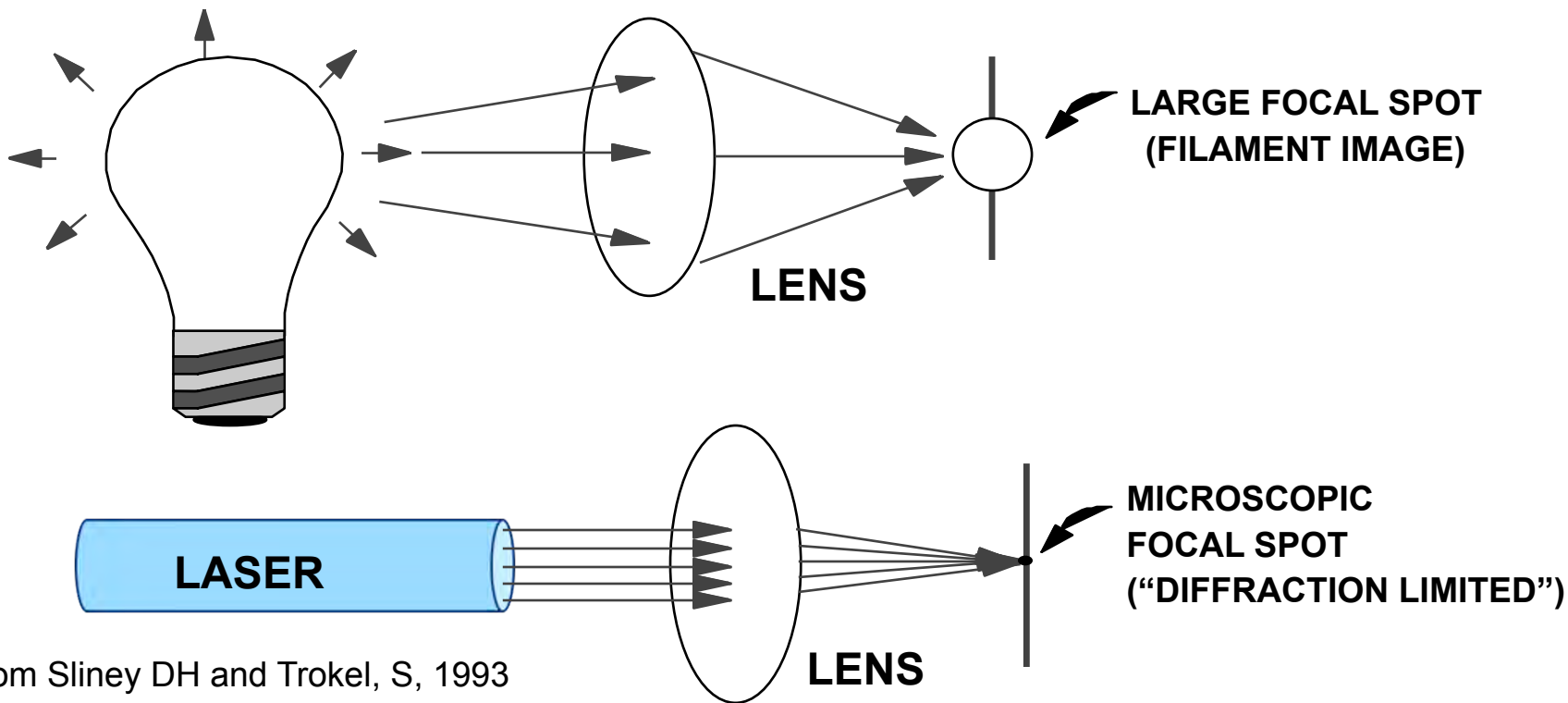


Figure 3 – Definition of throw ratio

IEC

Laser Brightness – RADIANCE



From Sliney DH and Trokel, S, 1993

Comparison of RADIANCE Values

Light Source	Radiance Value	Units
5 mW laser pointer	70	MW/m ² -sr
The SUN (visible λ)	7	MW/m ² -sr
30,000 lumen Laser cinema projector	2	MW/m ² -sr

If one looks directly into the lens – then you blink!

How are LIPs Regulated?

Per definition: **any and all LIP emissions = laser radiation**

Regulatory bodies base safety **regulations** on the **LASER classification** scheme

So Classification of LIP's = **Class 4** laser product

BUT...



By the end of 2014, the **classification scheme** in the laser safety standard for Projectors **updated** => **LIP** emission = **lamp**-based emission

How did LIPA Change the LOGIC?

- LIPA Commissioned Study: Tested optical characteristics of
 - 35mm film projector
 - Current Xenon short-arc digital cinema projectors
 - Prototype laser projectors (DLP Cinema® and LCoS)
- Lead Researcher: Dr. David Sliney
 - Casey Stack, Laser Compliance
 - Jay Parkinson, Phoenix Laser Safety
 - David Schnuelle, Dolby Laboratories
- 8 LIPs and Xenon projectors tested over 7 months



Study Conclusion: IF LIP Radiance = Lamp Radiance,
THEN... HAZARDS ARE EQUIVALENT

LIPA Peer-Reviewed Cover Story



- Published in ***Health Physics***, March 2014
 - Radiation Safety Journal
 - Official Journal of the Health Physics Society
- Peer review complete
- Cover story!

Additional analysis presented at
Society of Motion Picture & Television Engineers
Conference – October 22, 2013.





What the **SCIENCE** tells us...

Hazard Risk is based on **RADIANCE**

**For ~same brightness, LIP emission RADIANCE ~=
lamp projector emission RADIANCE**

Therefore -

**LIP regulations should conform to Lamp
projector regulations**

Who Regulates LIPs

International/Europe
USA



Major Regulatory Agencies





APPLICATION FOR A VARIANCE FROM 21 CFR 1040.11(c) FOR A LASER LIGHT SOURCE, DISPLAY, OR DEVICE

Guidance for Industry
Laser Products – Conformance with IEC 60825-1 and IEC 60601-2-22; Guidance for Industry and FDA Staff (Laser Notice No. 50)

Revised April 14, 2014

U.S. Department of Health and Human Services
 Food and Drug Administration
 10903 New Hampshire Avenue
 Silver Spring, MD 20910
 www.fda.gov



 **European Commission**
Enterprise and Industry

 Directorate-General for
Health & Consumer

CENELEC



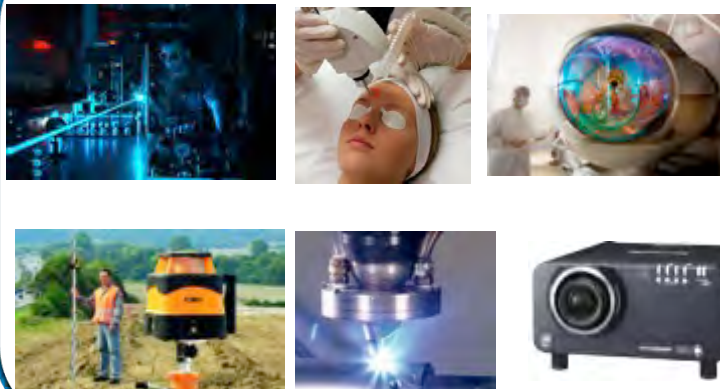
 **ANSI**
American National
Standards Institute

LIPA Strategy to change IEC, FDA Regs

LIPA's strategy to simplify and update regulations:

- Use scientifically validated “**Equivalent Hazard**” doctrine to harmonize LIP regulations with Lamp Projector regulations
- First with the IEC (Global Scope)
- Then recommend FDA conform with IEC Edition 3

“Old” IEC Laser Projector Regulation



IEC **60825-1** Ed 2 (2007)

Safety of Laser Products

Part 1: Equipment classification & Requirements

All laser product requirements are defined in **60825**

- Medical
- Industrial
- Laboratory
- Laser Welding
- **Laser Illuminated Projectors**

IEC 60825-1 was updated in 2014



IEC **60825-1** Ed **3** (2014)
Safety of Laser Products
Part 1: Equipment classification & Requirements



IEC **62471** Ed 1 (2006)
Photobiological safety of lamps and lamp systems

Carve-out for devices with RADIANCE $< (1 \text{ MW} \cdot \text{m}^{-2} \cdot \text{sr}^{-1})/\alpha$

LIP Regulation under IEC



IEC **60825-1** Ed 3 (2014)
Safety of Laser Products
Part 1: Equipment classification & Requirements



IEC **62471-5 Ed 1 (2015)**
Photobiological safety of Lamp Systems
for Image Projectors

IEC “DASH 5” SUCCESS!!!

IEC 62471-5:2015 Photo-biological safety of lamps and lamp systems
Part 5: **Image projectors**

Abstract

IEC 62471-5:2015(E) provides a **risk group classification system for image projectors**, and measurement conditions for optical radiation emitted by image projectors. It includes manufacturing requirements that may be required as a result of an image projector system being assigned to a particular risk group. Therefore, this part of IEC 62471 provides **safety requirements for lamp systems** that are intended to produce projected visible optical radiation, **such as theatre projectors**, data projectors and home-use projectors. The assigned risk group of a projector product also may be used by projector manufacturers to assist with any risk assessments, e.g. for occupational exposure in workplaces. **National requirements may exist** for the assessment of products or occupational exposure.

IEC'S New Approach: *Risk Groups*

- Laser safety standards IEC **EN 60825-1** → Classification based on **A**ccessible **E**mission **L**imits (**AEL**): Class 1 and 2 are defined as safe

- Broadband safety standards **IEC EN 62471** Classification → based on Accessible emission limits: **Risk group 0, 1 and 2 are defined as safe**

60825-1: Class 1 (8h) Class 1 Class 1M Class 2 Class 2M Class 3R Class 3B Class 4	62471-1: Risk Group 0 Risk Group 1 Risk Group 2 Risk Group 3	Risk: Inherent safe Safe reasonably foreseeable conditions of operation Safe, based on aversion responses (<0,25 s exposure) Potentially hazardous for eye and skin. Safety measures are required
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- **ICNIRP** guidelines define exposure limits, which in turn are **basis** for **ELVs** in the AORD and **AELs** in IEC standards

Risk Group Classification according IEC 62471-5:2015 FDIS (Final Draft International Standard)



RG3: **Potentially hazardous**, require controlled **user** and/or **installation requirements**
Cinema and staged applications



RG2: **safe** based on **aversion response** (blink reflex)
Home/office use projectors



RG1: **safe** for **prolonged staring**
Pico projectors



RG0: **inherently safe**



Regulatory Compliance for Cinema Manufacturers and Exhibitors

Manufacturers
Exhibitors

It is Legal to install LIP Systems in Theaters



DP4K-60L

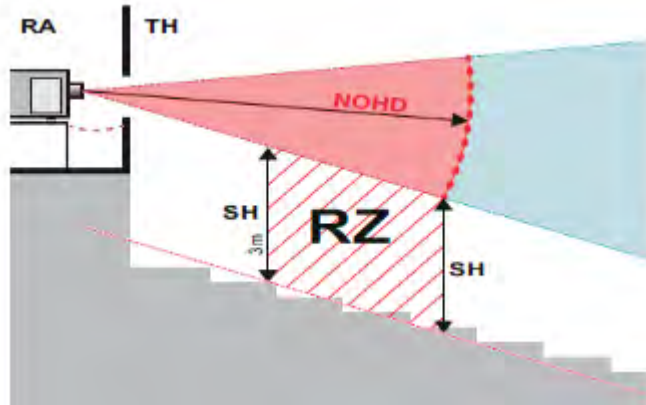
- e.g., DP4KL-60L = **Class 4** laser power *inside*
- Complies with strict engineering requirements
- Risk-based Hazard Distance (**HD**)
- Barco has received a **Variance** from US FDA
- Installation and information requirements

Manufacturer's Responsibilities

- Provide the end-user (theater operator):
 - All **required** information on how to **install** a LIP resulting in a safe installation
 - **Provide** installation and operator **training** and support
 - Provide all required **emission data** in order to make a risk assessment (**RA**) possible
- Release products to the market that **comply with strict safety standards**
- **Regulators will give more attention to high brightness emission**
- Manufactures have the **obligation** to provide their customers **training and guidance**

Exhibitor Regulatory Requirements

- Implement **local** government **safety regulation**
 - Laser light show **variance**
 - **Event safety** regulation
- Requirements based on **exposure** limits (**not laser class**)
 - LIP **operator**
 - Laser system Operator Training requirements
 - Projection booth requirements (restricted area, protective barriers)
 - Risk-based implementation
 - Cinema **visitor** (general public)
 - No exposure above safety limits is allowed in any case!
 - Physical barrier or sufficient separation height (**SH**) >3 meters within Hazard Distance (**HD**)





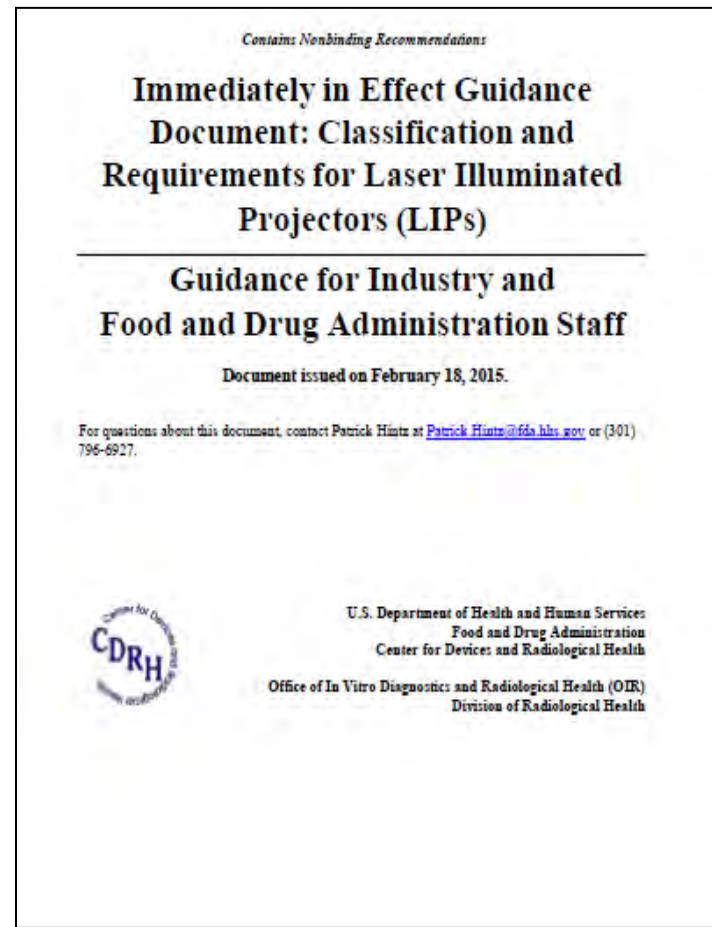
U.S. Regulatory Environment

FDA = Food and Drug Administration

CDRH = Center for Devices and Radiological Health

FDA Guidance Document

- Intended to address Laser Illuminated Projectors
- Immediately in effect
(as of February 18, 2015)
- “Document describes FDA’s intent...”
- “...does not establish legally enforceable responsibilities”
- “... non-binding recommendations”



Problems with New Guidance Document

- It incorrectly **compares Risk Groups** with laser **Classes** in terms of risk
 - » Some Laser Regulations still apply (e.g. LSO, State regulations)
- **References outdated IEC standards** for **characterizing LIPs**
- Mismatch in evaluation conditions, **distance** for **determination of Risk Groups**
 - » Overstates risk of many projectors
- **Overly restricts access** --
 - » Entire light beam, not just within Hazard Distance
- **Even more projectors require a Variance application** than previously

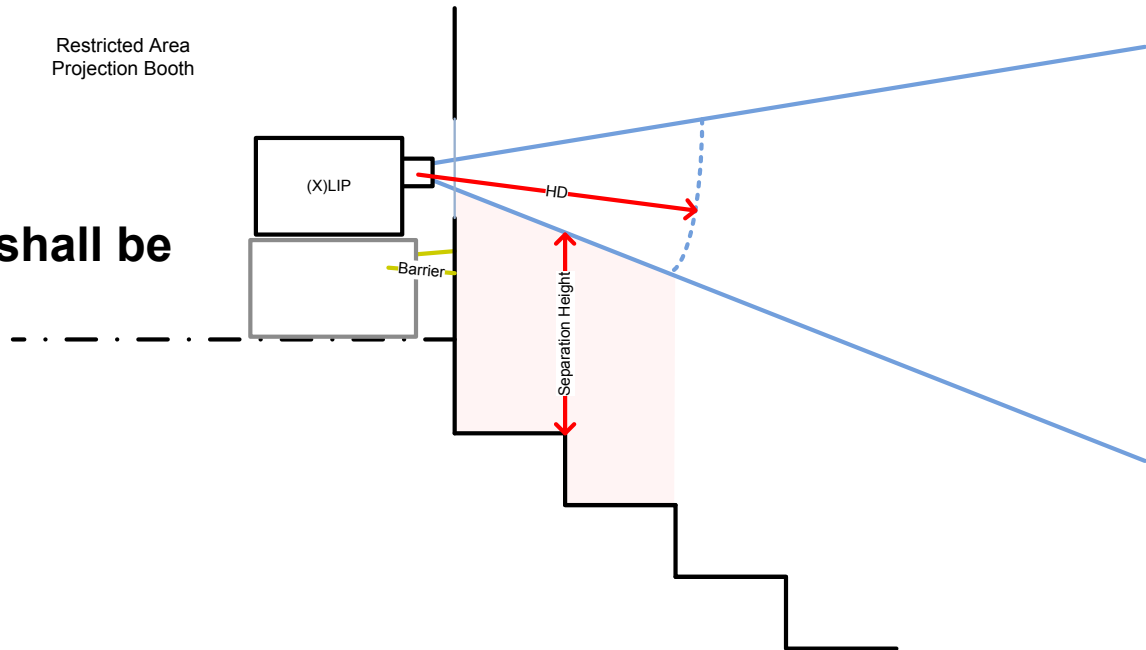
Managing Hazard Distance (HD)

FDA Guidance Document requires:

“...a restricted access area that extends beyond the beam hazard distance.”

Requested revision:

“No direct exposure to beam shall be permitted *within* the Hazard Distance”



Restricted Area
Projection Booth

(X)LIP

HD

Barrier

Separation Height

LIPA Urgent FDA Recommendations

- **Revise** the Guidance Document
- Harmonize **classification measurement** methods with International (IEC) standards
- Adopt **reasonable safety precautions** for Risk Group 3 projectors
 - Harmonize with latest IEC standards
 - IEC **60825-1** Ed **3 (2014)**
 - IEC **62471-5** Ed **1 (2015)**
- Then **NO PRODUCT VARIANCES** will be required

Bottom Line for Digital Cinema

- **You can legally purchase, import, operate and enjoy LIPS today!**
 - Manufacture requires a product variance for each model / family
 - But the operator (theater) typically does not need variance
 - **Regulatory compliance is required** (defined in each variance)
 - Reporting, record-keeping on installation
 - permanent immobile installation
 - Separation Height = HD >3 meter IEC (2.5 meter for FDA variances)
 - Signage for Access controlled booth
 - Emergency shut-down capability
 - State, local and municipal regulations
 - *ANSI Z-136 requirements (e.g. Laser Safety Officer)**
 - **Variance will need to be renewed** (*typically 5 year term*)
- *Subject to interpretation;
Consult Local Legal Counsel



Summary

LIPs are safe

Regulatory Compliance has been Simplified



Summary

- Laser Illuminated Projectors (LIPs) will be the foundation of **Next-Generation Cinema**
- With LIPA's guidance, global standards have evolved and the regulatory **environment is becoming more favorable**
- LIPs are safe and regulatory compliance has been simplified **thanks to LIPA's good work**
- **Commercialization has begun** and early adopters are quickly learning how to safely deploy, operate and profit from Laser Illuminated Projection



Thank You for Your Interest

Questions?